Safer Seward Highway Project
Seward Highway MP 98.5 to 118,
Bird Flats to Rabbit Creek

Project No.: Z566310000/0A31034

Environmental Assessment

Appendix K: Essential Fish Habitat Report

DRAFT

December 2025

Prepared for:

Alaska Department of Transportation and Public Facilities

Prepared by:

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THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

Department of Transportation and Public Facilities

OFFICE OF THE COMMISSIONER

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April 1, 2025

Charlene Felkley
Essential Fish Habitat Coordinator
222 W. 7th Avenue, Suite 552
Anchorage, AK 99513

Re: Seward Highway MP 98.5 to 118, Bird Flats to Rabbit Creek, Safer Seward Highway Project
Z566310000/0A31034
Essential Fish Habitat Assessment

Dear Charlene Felkley:

The State of Alaska Department of Transportation and Public Facilities is proposing to realign the Seward Highway and Alaska Railroad Corporation tracks along a 19.5-mile segment Bird Flats and Potter Marsh to: 1) reduce crash rates and crash severity; 2) improve mobility and reliability; and 3) safely accommodate mixed uses in the corridor. Construction operations are expected to begin as early as 2026 and last through 2035.

DOT&PF has determined that construction of the Safer Seward Highway Project would affect Essential Fish Habitat (EFH) for Alaska's five species of pacific salmon managed under the *Fisheries Management Plan for the Salmon Fisheries in the EEZ off Alaska* (2024) as well as eight groundfish species managed under the *Fishery Management Plan for the Groundfish Fisheries of the Gulf of Alaska* (2024). Please find the enclosed EFH Assessment prepared for the Project. DOT&PF intends to work with ADF&G and NOAA throughout the Project's permitting process to correctly implement proposed conservation measures and minimize impacts to EFH.

Please feel free to contact me at (907) 269-0539 or via email at brian.elliott@alaska.gov. You may also contact our environmental consultant for the Project, Simon Wigren, HDR, Inc., at (907) 644-2189 or via email at simon.wigren@hdrinc.com.

Sincerely,

Brian Elliott

Brian Elliott
Regional Environmental Manager
DOT&PF

"Keep Alaska Moving through service and infrastructure."

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried out by DOT&PF pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated April 13, 2023, and executed by FHWA and DOT&PF.

Enclosure:
Attachment 1: Essential Fish Habitat Assessment

Copy to: Folder where document should be filed
cc: Name, Working Title Add Region if going out of NR; alphabetize by last name

THE STATE of ALASKA
GOVERNOR MIKE DUNLEAVY

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April 3, 2025

Charlene Felkley
Essential Fish Habitat Coordinator
222 W. 7th Avenue, Suite 552
Anchorage, AK 99513

Re: Seward Highway MP 98.5 to 118, Bird Flats to Rabbit Creek, Safer Seward Highway Project
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Enclosure:
Attachment 1: Essential Fish Habitat Assessment

Safer Seward Highway Project
Seward Highway MP 98.5 to 118,
Bird Flats to Rabbit Creek

Project No.: Z566310000/0A31034

Essential Fish Habitat Assessment

REV 0

April 2025

Prepared for:

Alaska Department of Transportation and Public Facilities

Prepared by:

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Acronyms and Abbreviations

ADF&G	Alaska Department of Fish and Game
ARRC	Alaska Railroad Company
AWC	Anadromous Waters Catalog
BMP	best management practice
CFR	Code of Federal Regulations
DOT&PF	Department of Transportation and Public Facilities
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
FHWA	Federal Highway Administration
FMP	fisheries management plan
GOA	Gulf of Alaska
HTL	high tide line
m	meters
MHW	mean high water
MP	Milepost
MSA	Magnuson-Stevens Fishery Conservation and Management Act
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
OHW	ordinary high water
Project	Safer Seward Highway Project, Mileposts 98.5 to MP 118, Bird Flats to Rabbit Creek
SPCC	Spill Prevention, Control, and Countermeasure
U.S.	United States

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1 Introduction

The State of Alaska Department of Transportation and Public Facilities (DOT&PF) is proposing to realign and construct safety improvements to the Seward Highway from Mileposts (MP) 98.5 to MP 118, Bird Flats to Rabbit Creek, or the Safer Seward Highway Project (Project; Figure 1-1).

The beginning of the Project is at Latitude 60.9511, Longitude -149.4027 (MP 98.5 at Bird Flats); and the end of the Project is at Latitude 61.0871, Longitude -149.8344 (MP 118, north of Potter Marsh, at the intersection/overpass to Rabbit Creek Road). The Project is entirely within the Municipality of Anchorage, Alaska, and includes the communities of Rainbow, Indian and Bird. The proposed Project is being developed with a combination of State of Alaska and Federal-Aid Highway Program funds administered by the Federal Highway Administration (FHWA).

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA), this Essential Fish Habitat (EFH) assessment describes the proposed Project and its components that may affect designated EFH and species managed under a Fisheries Management Plan (FMP). It identifies potential impacts to EFH and FMP-managed species, outlines proposed measures to minimize potential effects from the Project, and summarizes DOT&PF's determination.

1.1 Purpose and Need

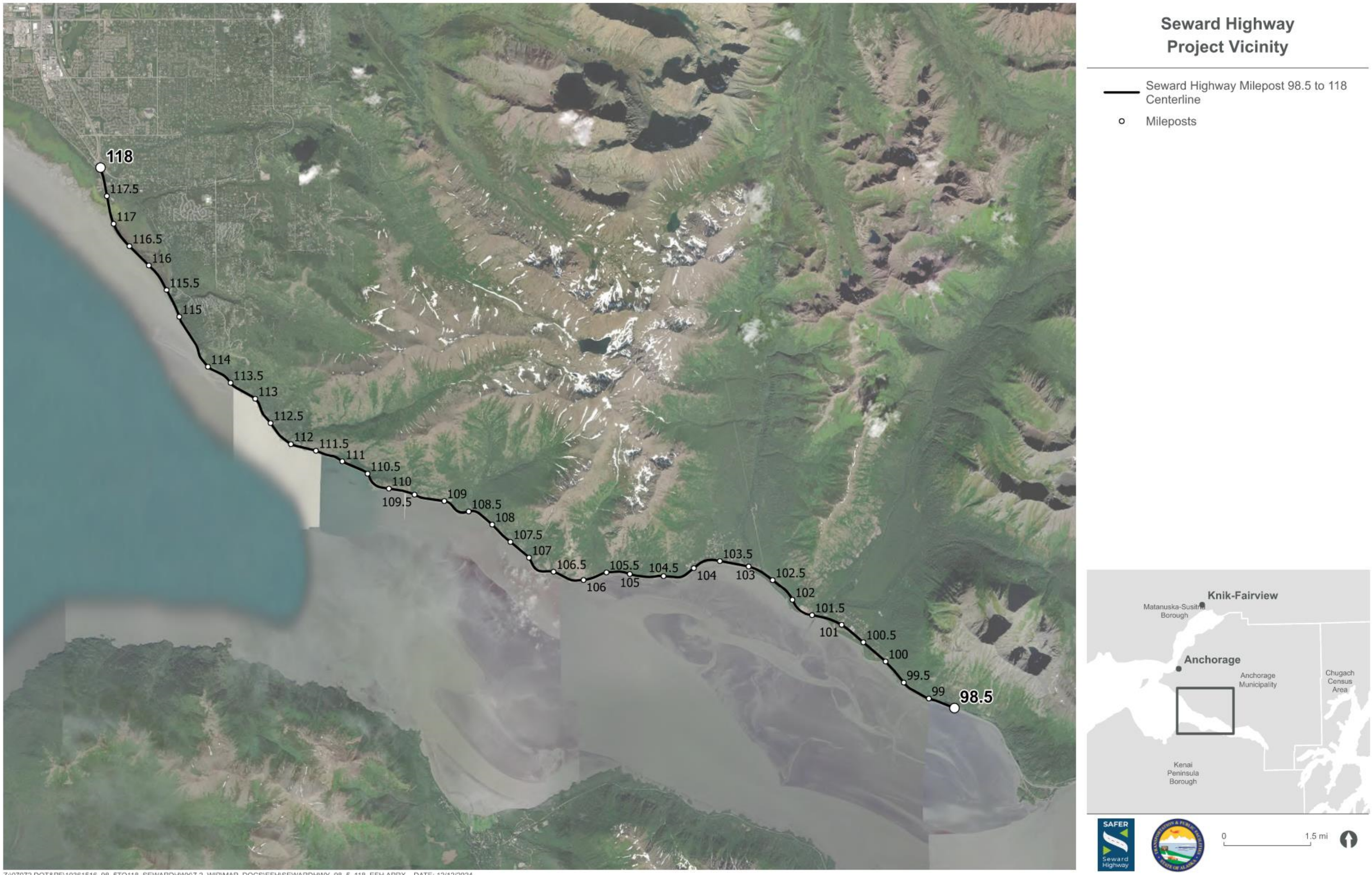
The purpose of the Project is to improve safety by reducing crash rates and severity, improving mobility and reliability, and safely accommodate mixed uses in the corridor.

1.1.1 Project Objectives

This is a safety project driven by multiple, inter-related needs.

- **Need 1: Reduce Crash Rates and Crash Severity.** In 2006, this stretch of the Seward Highway was designated as the state's first Highway Safety Corridor. Despite additional enforcement presence, community education, improved signage, and safety improvement projects, high crash rates and crash severity issues remain. Crashes are caused by limited passing opportunities, curvy and constrained road geometry, and poor access management. Extreme driving conditions, including atmospheric (e.g., high winds, rain, snow, and dark conditions) and road surface (e.g., wet, icy, snowy, and changes that occur at the freeze-thaw line), increase the risk of drivers losing control and sliding off the road or into oncoming traffic. Due to heavy, summer traffic volumes, drivers spend considerable time following vehicles without safe passing opportunities, resulting in frustrated drivers making high-risk passing maneuvers and increasing the risk of head-on collisions.

Figure 1-1. Vicinity map



- **Need 2: Improve Mobility and Reliability.** Mobility within the Seward Highway corridor begins to fail during summer weekend peaks. Summer traffic volumes can result in long platoons (lines) of vehicles. When vehicles slow to turn or pull over for scenic or wildlife viewing, these actions pulse back through the lines, causing variable speeds. Mobility is also degraded by high truck and recreational vehicle volumes; uncontrolled access to and from scenic turnouts and trailheads, driveways, and intersections; and difficult weather and road conditions. Crashes, engine trouble, and poor weather or road conditions can cause unexpected delays, which reduces reliability. Emergency lane or road closures following collisions, rockfall, or avalanches cause miles- and hours-long backups since no alternative road routes exist through the Project area. Access to the emergency location is limited by the two-lane facility, slowing the response times of emergency services in the event of lane closure or backup.
- **Need 3: Safely Accommodate Mixed Uses in the Corridor.** The Project corridor's multitude of scenic, natural, and recreational attractions contribute to the highway's designation as a National Scenic Byway, All-American Road, and Alaska Scenic Byway. However, the popularity of the attractions alongside, and including, the road exacerbates the safety, mobility, and reliability issues. A need exists to maintain the corridor's scenic qualities while safely accommodating the needs of all users, including recreators and tourists accessing attractions, local residents accessing their homes and communities, commercial and through-travelers making long-distance trips, and bicyclists and pedestrians. Numerous access points to pullouts and private driveways mean that vehicles are making many turning movements throughout the corridor. Vehicles pulled onto the highway shoulders create safety hazards. Gaps in non-motorized pathways result in people biking and walking along or across the highway to access the attractions, creating safety and mobility issues.

2 Proposed Action

The Proposed Action would reconstruct the Seward Highway corridor to incorporate a four-lane divided highway with a 55 mile per hour design speed along the entire 20-mile Project corridor. The Proposed Action would shift approximately 7 miles of railroad alignment and tracks to accommodate the widened highway and straightened highway curves. The expanded corridor would also include a pedestrian pathway along the entire length with additional parking at existing trailheads and scenic areas.

The Proposed Action would result in impacts to EFH from culvert replacements, construction of new bridges, and reconstruction of the highway and Alaska Railroad fill embankments. All reconstructed or relocated sections of railroad track would include coastal armoring and sufficient embankment to allow room for a second track to be added in the future. The fill in fresh and marine waters would fill EFH (Appendices A and B, respectively) to support portions of the highway and railroad embankment. A total of nine highway and two railroad culverts would be replaced, while three highway and one railroad bridges would be constructed (Table 2-1). Proposed conservation measures are listed in Section 5 and are part of the project description. DOT&PF intends to work with NMFS and the Alaska Department of Fish and Game

(ADF&G) during project permitting to implement conservation measures and minimize impacts to fish and EFH.

2.1 Culvert Construction

Culverts supporting the highway and railroad embankment would be replaced in accordance with Tier 3 design criteria of the Memorandum of Agreement between the ADF&G and DOT&PF, dated August 29, 2021. Temporary stream diversions would be implemented where culverts are replaced or extended. Diversion lengths and design would be subject to ADF&G permit stipulations and designed to not compromise fish passage. Construction and in-water work windows for culverts and bridges would be timed to minimize adverse effects to salmon during critical life stages. Windows of construction would be planned through agency consultation and incorporated into all aspects of the Project for all in-stream work.

DOT&PF would be required to apply for a Fish Habitat Permit accompanied by an Aquatic Resources Permit prior to construction. If issued by ADF&G, the permits would allow the contractor to move fish in dewatering areas to upstream reaches, reducing potential impacts from culvert replacement on fish. Culverts would be installed to match existing grade and elevations wherever practical. Pre- and post-construction surveys would be conducted at culvert locations. Elevations would be derived from these surveys to avoid changes to area hydrology from culvert replacements or extensions.

ADF&G rates culverts on their suitability for fish passage by assessing certain critical values. The three critical values are culvert gradient, culvert constriction, and outfall height. Assessment of these values results in the culvert receiving a red or green classification. A green classification indicates all critical values are acceptable, and a red classification is given if one or more critical values are found to be unacceptable. Two culverts within waters listed in the Catalog of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes (or Anadromous Waters Catalog [AWC]) that are within the proposed Project area have a red rating, Rabbit and Potter Creeks (ADF&G 2024). The Proposed Action would replace both culverts.

2.2 Bridge Construction

In-water piers may be constructed to support highway and railroad bridges below the high tide line (HTL). Piers would be driven into the substrate by either impact or vibratory hammers. The pier footprint within EFH would be minimized to the maximum extent practicable. No abutments would be constructed below the HTL. Temporary bridge construction and bridge piers would not create migration barriers for adult or juvenile salmon. Where possible, existing bridges supporting the Seward Highway would remain in place to support the newly constructed Highway and limit additional bridge construction. None of the existing Seward Highway bridges would be removed as part of the Proposed Action.

2.3 Project Work within EFH

Table 2-1 provides information regarding construction within EFH. Section 4 describes potential impacts from construction and the longevity of the Project. Maps detailing EFH impacts are provided in Appendices A and B (freshwater and marine EFH, respectively). Acres of fill, distance to blasting, and linear feet of streams impacted in this assessment have been derived from desktop analyses based on the current level of design. Unless otherwise noted, areas and lengths of streambed impacts are subject to change during final design.

2.3.1 Rabbit Creek (247-60-10320)

Construction at Rabbit Creek would include a fish passage highway culvert, four highway flood relief pipes, and a fish passage railroad culvert. Culverts and relief pipes would be constructed to maintain water levels within Potter Marsh. The flood relief pipes would be constructed adjacent to the highway culvert (two on each side) to provide hydrologic relief during periods of high flow. The new highway culvert would not extend beyond its current location on the eastern side of the highway. The culverts would be designed to satisfy the 50-year design discharge.

2.3.2 Little Survival Creek (247-60-10320-2012)

No work would occur within Little Survival Creek. Blasting may occur to the south.

2.3.3 Potter Creek (247-60-10310)

The Proposed Action would include a new culvert beneath the Seward Highway at Potter Creek. Additionally, the creek would be filled where it is parallel to the highway, between the Potter Section House Headquarters and the new culvert. Potter Creek would be rerouted to maintain fish passage to the headwaters of Potter Creek.

The culvert beneath the highway at Potter Creek would be replaced with a new culvert. On the western side of the highway, the culvert would extend beyond its current footprint to support the new, southbound lane. To the east of the highway, the culvert would extend beyond the confluence at Potter Creek, Potter Creek Middle Fork, and Potter Creek South Fork. These three creeks would be reconstructed to form a singular channel through the newly constructed highway culvert. Channel redirection would be supported by a wingwall. Fill would need to be placed in Potter Creek and the surrounding wetland to support the highway. Once rerouted, blasting may occur nearby.

2.3.4 Potter Creek Middle Fork

Anadromous fish species were identified at Potter Creek Middle Fork during field reconnaissance for the Project completed in September 2023 (Section 3.2.1). An AWC nomination was submitted to ADF&G to document Project findings. Details on channel reconstruction associated with Potter Creek, Potter Creek Middle Fork, and Potter Creek South Fork are provided in Section 4 The three creeks would likely be rerouted through the Potter Creek Middle Fork channel.

2.3.5 Potter Creek South Fork (247-60-10310-2004)

Up to 165 feet of Potter Creek South Fork would be rerouted to form a single channel with Potter Creek and Potter Creek Middle Fork. Creek rerouting would be similar to what is shown in Appendix A. Details on channel reconstruction are provided in Section 4.

Table 2-1. Proposed Action construction that may impact EFH

Nearest MP	Waterbody Name	AWC Number	Design Feature	Design Length (linear feet)	Design Diameter (inches)	Current Diameter (inches)[a]	Fill (acres)	Streambed Impacted (linear feet)	Approximate Distance to Blasting (feet)[b]
117.5	Rabbit Creek	247-60-10320	Highway culvert	220	141–86	(3) 60	—	—	> 1,000
117.5	Rabbit Creek	247-60-10320	Four highway flood relief pipes	220	60	—	—	—	> 1,000
117.5	Rabbit Creek[c]	247-60-10320	Railroad culvert	< 200	141–86	—	—	100	> 1,000
117.5	Little Survival Creek	247-60-10320-2012	Road construction	—	—	—	—	—	380
115	Potter Creek[c]	247-60-10310	Highway culvert and creek realignment	220	120	120	—	920	250
115	Potter Creek, Middle Fork[d]	N/A	Creek realignment	—	—	—	—	-	250
115	Potter Creek, South Fork	247-60-10310-2004	Creek realignment	—	—	—	—	165	250
111.5	McHugh Creek	247-60-10300	Highway and railroad culvert	220	120	60	—	165	1,000
111.5	McHugh Creek	247-60-10300	Highway flood relief pipe	285	60	60	—	—	1,000
103.5	Unnamed Stream	247-60-10292	Culvert extension	130	54	-	—	130	> 1,000
103	Indian Creek	247-60-10290	Two highway and one railroad bridge	120–200	—	—	—	405	> 1,000
103	Bird Creek	247-60-10280	Highway and pedestrian bridge	200	—	—	0.2	100	> 1,000
100.5	Birdhouse Creek	247-60-10278	Creek realignment	—	—	—	—	110	> 1,000
99.5	Unnamed Creek at MP 99.5[d]	N/A	Fill placement in headwaters	—	—	—	—	—	> 1,000
98.5–118	Turnagain Arm	N/A	Fill placement	—	—	—	105	—	Varies
Total	—	—	—	—	—	—	**105.2**	**2,095**	—

Notes: N/A = not applicable
[a] Information only available for sites where the existing culvert is greater than 48 inches
[b] Distances are estimated based on desktop analysis. Geotechnical surveys would be conducted to determine where blasting would occur.
[c] Culvert received a red rating by ADF&G (see Section 4.2.1)
[d] Nominated to the AWC based on 2023 field reconnaissance efforts (see Section 3.2.1)

2.3.6 McHugh Creek (247-60-10300)

The culverts beneath the highway and railroad would be extended at McHugh Creek to support the new alignment and maintain fish passage. The current highway and railroad culverts are both 6 feet in diameter. Additional segments would be added to the lower culvert to support both the southbound lane and Alaska Railroad Company (ARRC) crossing.

2.3.7 Unnamed Creek (247-60-10292)

Currently, the only portion of Unnamed Creek at approximate MP 103.5 that is EFH is downstream of the culvert through the ARRC embankment because the existing culvert is a barrier to fish passage. The Project would impact a small segment of EFH to construct a fish passage culvert through the ARRC embankment and the highway embankment. The stream would then be connected to the upstream segments on the north side of the highway.

2.3.8 Indian Creek (247-60-10290)

Construction at Indian Creek includes a new railroad bridge, new bridge for the southbound lanes, and new bridge for the northbound lanes. The frontage road would use the existing highway bridge. No piers or abutments would be constructed below ordinary high water (OHW) within EFH to support the railroad bridge. The bridge would be supported on either side of the crossing by Class III riprap (Section 4). The northbound highway bridge would support two lanes, and the southbound bridge would support three lanes. No piers would be constructed within EFH to support the highway bridges at Indian Creek.

2.3.9 Bird Creek (247-60-10280)

Construction at Bird Creek would include two retaining walls, a new bridge to support the northbound lane, a pedestrian bridge, and a pedestrian overlook. A retaining wall would be constructed on either side of the new bridge to route flow through the channel beneath the bridge. Both retaining walls would be on the upstream side of the new bridge. The retaining wall and fill behind the retaining wall supporting the span would remove EFH.

The existing highway bridge over Bird Creek would be repurposed to support the Proposed Action's southbound lane. The new bridge supporting the northbound lane would be constructed in a design similar to the existing bridge. The bridge would require the construction of two piers to support the span, which would remove EFH.

A new pedestrian bridge would be constructed on the northern side of the new bridge spanning Bird Creek. No additional piers or fill would be required for this pathway. A pedestrian overlook would be constructed on Bird Creek. The overlook would be constructed with its supports below mean high water (MHW) and remove EFH.

2.3.10 Birdhouse Creek (247-60-10278)

Birdhouse Creek would be filled to support the highway embankment. Before filling Birdhouse Creek, a new channel would be reconstructed. A new pedestrian bridge would be constructed over the new Birdhouse Creek channel and would not require piers below MHW. Upstream of the Birdhouse Creek AWC segment, new culverts would be constructed to maintain flow in Birdhouse Creek beneath the pedestrian walking trail and highway.

2.3.11 Unnamed Stream at MP 99.5

Fill would be placed upstream of the nominated AWC portion of Unnamed Stream at MP 99.5 to support the southbound lane. A channel would be constructed to maintain flow within the non-AWC component of the stream.

2.3.12 Turnagain Arm

Fill would be placed in more than 105 acres within the marine environment below the HTL to support the railroad and highway realignments (Appendix B). Outside of culverts and bridge abutments, fill in the marine environment would be composed of Class III riprap. Class III riprap is defined as being 50 to 100 percent fill weighing 700 pounds or more, 0 to 15 percent fill weighing up to 25 pounds, and 0 to 10 percent fill weighing more than 1,400 pounds. Prior to new fill being placed adjacent to the existing ARRC track, the coastal armament along the existing track would be removed. Rock fill within the marine environment would be placed onto mudflats at low tide when the mudflats are exposed.

3 Essential Fish Habitat

The MSA governs marine fisheries management in United States federal Waters. The intent of the MSA is to prevent overfishing; rebuild overfished stocks; increase long-term economic and social benefits; ensure a safe and sustainable supply of seafood; and protect habitat that fish need to spawn, breed, feed, and grow to maturity. The MSA defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.” EFH within the Project area includes the marine waters of Turnagain Arm, tidally influenced ponds such as Potter Marsh, and freshwater anadromous streams. Species with EFH within the Project area are listed in Section 3.1 and their relevant life history information is provided in Section 3.3.

3.1 EFH within the Proposed Project Area

The Project area contains both marine EFH in the Turnagain Arm as well as freshwater EFH that consists of rivers and streams.

3.1.1 Marine EFH – Turnagain Arm

Turnagain Arm is located at the northern extent of Cook Inlet and south of Knik Arm. Turnagain Arm is a coastal area surrounded by the Chugach Mountains to the north and the Kenai Mountains to the south. Where it joins Cook Inlet, Turnagain Arm is bordered by the Anchorage lowland to the north and Kenai lowland to the south. Turnagain Arm is surrounded by a maritime zone along the eastern side of Turnagain Arm and the transitional climate zone in the west. This creates a strong precipitation gradient, with the west being significantly drier than the east. The surrounding mountains influence interactions between air masses coming from the Gulf of Alaska and the surrounding continental air masses producing complex wind regimes. This creates early summer prevailing winds from the south that have a significant effect on vegetation dispersal and growth (Ager and Carrara 2010).

Turnagain Arm has extreme physical habitats characterized by large tidal ranges, strong currents, massive inputs of glacial and coastal sediments, and severe seasonal ice scour

(Pentec Environmental 2006). Several glacial streams enter the head of Turnagain Arm and deliver substantial quantities of sediment. The strong currents, wind waves, and high sediment inputs result in large amounts of suspended sediment and high turbidity throughout the Arm. Most of the seabed of Turnagain Arm consists of mud and sandflats. Limited areas of bedrock bench occur intertidally within areas such as Beluga Point and Bird Point (Pentec Environmental 2006).

Coastal zones of Turnagain Arm provide a unique interface that facilitates land-sea interactions and promotes the exchange of energy, water, nutrients, sediments, and organisms. This energy exchange influences biodiversity within coastal zones (Gleason et al. 2011). Turnagain Arm is subject to extreme tides up to 39 feet, leaving much of the Arm exposed at low tide. Turnagain Arm experiences strong currents, with the tide occasionally taking the form of a tidal bore with a wave height up to six feet. During winter, Turnagain Arm experiences significant ice cover formed from estuarine water. The ice is subject to intense winds and often moves as pack ice (Mulherin et al. 2001).

Estuarine and marine waters of Turnagain Arm within the fill footprint of the Proposed Action are listed as EFH for 13 species of fish at various life stages. Table 3-1 provides a description of EFH for each species and life stage.

Table 3-1. Fisheries management plan-managed species with EFH within Turnagain Arm

Species	Latin Name	Life Stage	Location
Alaska plaice	*Pleuronectes quadrituberculatus*	Egg	Pelagic waters throughout the entire upper shelf and upper slope (0 to 500 m) throughout the GOA during spring
Alaska plaice	*Pleuronectes quadrituberculatus*	Larvae	Pelagic waters throughout the entire upper shelf and upper slope (0 to 500 m) throughout the GOA
Dover sole	*Microstomus pacificus*	Larvae	Pelagic waters along the entire shelf and slope (0 to 3,000 m) throughout the GOA
Flathead sole	*Hippoglossoides elassodon*	Larvae	Pelagic waters along the entire shelf and slope (0 to 3,000 m) throughout the GOA
Northern rock sole	*Lepidopsetta polyxystra*	Larvae	Pelagic waters along the entire shelf and upper slope (0 to 1,000 m) throughout the GOA
Pacific cod	*Gadus macrocephalus*	Larvae	Pelagic waters along the inner and middle shelf (0 to 100 m) throughout the GOA
Southern rock sole	*L. bilineata*	Larvae	Pelagic waters along the entire shelf and upper slope (0 to 1,000 m) throughout the GOA
Yellowfin sole	*Limanda aspera*	Egg	Pelagic waters along the entire shelf and upper slope (0 to 500 m) throughout the GOA
Rex sole	*Glyptocephalus zachirus*	Egg	Pelagic waters along the entire shelf and upper slope (0 to 500 m) throughout the GOA during spring
Rex sole	*Glyptocephalus zachirus*	Larvae	Pelagic waters along the entire shelf and upper slope (0 to 500 m) throughout the GOA

Species	Latin Name	Life Stage	Location
Chinook salmon	*Oncorhynchus tshawytscha*	Estuarine juvenile	Within estuarine areas identified by the salinity transition zone and mean HTL within nearshore waters generally between April and September
Chinook salmon	*Oncorhynchus tshawytscha*	Marine juvenile	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ generally between April and February
Chinook salmon	*Oncorhynchus tshawytscha*	Marine immature and maturing adult	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ
Chum salmon	*O. keta*	Estuarine juvenile	Within estuarine areas identified by the salinity transition zone and mean HTL within nearshore waters
Chum salmon	*O. keta*	Marine juvenile	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ up to depths of 50 m
Chum salmon	*O. keta*	Marine immature and maturing adult	Marine waters from the mean HTL to 200-nm limit of the U.S. EEZ up to depths of 200 m
Coho salmon	*O. kisutch*	Estuarine juvenile	Within estuarine areas identified by the salinity transition zone and mean HTL within nearshore waters
Coho salmon	*O. kisutch*	Marine juvenile	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ generally between June and September
Coho salmon	*O. kisutch*	Marine immature and maturing adult	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ until they return to freshwater as adults during late summer
Pink salmon	*O. gorbuscha*	Estuarine juvenile	Within estuarine areas identified by the salinity transition zone and mean HTL within nearshore waters generally between late April through June
Pink salmon	*O. gorbuscha*	Marine juvenile	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ up to depths of 200 m
Pink salmon	*O. gorbuscha*	Marine immature and maturing adult	Marine waters from the mean HTL to 200-nm limit of the U.S. EEZ up to depths of 200 m
Sockeye salmon	*O. nerka*	Estuarine juveniles	Within estuarine areas identified by the salinity transition zone and mean HTL within nearshore waters generally between March and early August
Sockeye salmon	*O. nerka*	Marine juvenile	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ up to depths of 50 m
Sockeye salmon	*O. nerka*	Marine Immature and Maturing Adults	Marine waters from the mean HTL to the 200-nm limit of the U.S. EEZ up to depths of 200 m

Source: NPFMC 2018, 2024
Notes: EEZ = Exclusive Economic Zone; GOA = Gulf of Alaska, m= meters; nm = nautical miles; U.S. = United States; references to GOA in this table include Turnagain Arm

3.2 Freshwater EFH

Streams and rivers provide freshwater EFH for Pacific salmon. Salmon use freshwater systems for migrations of inmigrating adults and outmigrating juveniles. Adults rely on the freshwater habitats connected to Turnagain Arm for spawning and rearing substrates. Salmon embryos and alevin need the spawning substrates for protection from winter conditions. Additionally, salmon source necessary nutrients and prey during spring emergence and rearing from these systems (NPFMC 2018).

The Proposed Action footprint crosses nine anadromous waterbodies listed in the AWC and are considered EFH. Two additional creeks proposed to ADF&G to be added to the AWC may be impacted by the proposed Project and are considered EFH for this assessment (Table 3-2).

Table 3-2. AWC within the Proposed Action footprint

AWC Waterbody	Coho Salmon	Chinook Salmon	Chum Salmon	Pink Salmon	Sockeye Salmon	Dolly Varden
Rabbit Creek (247-60-10320): AWC segment exists on both sides of the highway. Rabbit Creek feeds directly into Turnagain Arm.	S R	S R	P	S	P	S
Little Survival Creek (247-60-10320-2012): Flows adjacent to the Seward Highway through Potter Marsh and feeds into Potter Creek. It exists exclusively on the eastern side of Seward Highway.	R	R	—	—	—	—
Potter Creek (247-60-10310): AWC segment exists on both sides of the highway. Potter Creek feeds directly into Turnagain Arm.	R	—	—	P	—	—
Middle Fork Potter Creek[a]: Has a confluence with Potter Creek on the eastern side of the highway.	R	—	—	—	—	—
South Fork Potter Creek (247-60-10310-2004): Has a confluence with Potter Creek on the eastern side of the highway.	R	—	—	—	—	—
McHugh Creek (247-60-10300): AWC segment exists on both sides of the highway. Water in McHugh Creek is sourced by McHugh Pond, and it feeds directly into Turnagain Arm.	R	—	—	—	—	—
Unnamed Creek (247-60-10292): AWC segment exists exclusively on the Turnagain Arm side of the highway.	R	—	—	—	—	—
Indian Creek (247-60-10290): AWC segment exists on both sides of the highway. Indian Creek flows directly into Turnagain Arm.	P R	P	—	P S	—	—
Bird Creek (247-60-10280): AWC segment exists on both sides of the highway. Bird Creek is sourced by Penguin Creek and flows directly into Turnagain Arm.	P S	S R	S	S	—	—
Birdhouse Creek (247-60-10278): AWC segment exists exclusively on the Turnagain Arm side of the highway and flows directly into Turnagain Arm. Sections of Birdhouse Creek upstream of the AWC segment flow through a culvert beneath the highway and a pedestrian bridge span.	R	—	—	—	—	—
Unnamed Creek[a]: Feeds directly into Turnagain Arm and flows beneath a railroad culvert.	R	—	—	—	—	R

Source: Giefer and Graziano 2024
Note: R = rearing; S = spawning; P = present
[a] Fish presence identified in 2023 sampling efforts and submitted for AWC nomination

3.2.1 Field Reconnaissance

On September 28 and 29, 2023, HDR conducted field efforts to identify waterbodies not listed in the AWC that may contain fish. HDR also sampled known AWC waterbodies for fish presence.

HDR visited 32 potential locations between MPs 98.5 and 118 to conduct minnow trapping. Of the 32 locations visited, 17 were identified as having a potential for fish presence and were sampled based on their gradient. At each location, one minnow trap was deployed. Table 3-3 provides sampling details.

Steep cliffs and high stream gradient make most freshwaters around the highway not suitable for fish. Most sampling occurred at the southern extent of the Project area, in small ponds and streams that are constricted by the Chugach Mountains and Turnagain Arm. The streams and ponds sampled were all connected to Cook Inlet by culverts beneath the Alaska Railroad and the Seward Highway.

Table 3-3. Field site physical characteristics

Site	Waterbody Name	Latitude	Longitude	Thalweg Depth (m)	Left Bank Angle (degrees)[a,b]	Right Bank Angle (degrees)[a,b]	Dominant Substrate[b]	Wetted Width (m)	Primary Habitat Type[b]
01A	Potter Creek South Fork	61.05046	-149.79443	0.14	> 75	> 75	Sand	0.23	Run
01B	Potter Creek Middle Fork	61.05053	-149.79421	0.13	< 25	< 25	Sand	0.23	Run
01C	Potter Creek	61.05059	-149.79444	0.13	< 25	< 25	Cobble	0.78	Run
02A	Ballpark Creek	60.98425	-149.49778	0.09	25–75	25–75	Pebble	0.60	Run
02B	Ballpark Creek	60.98384	-149.49559	0.10	> 75	25–75	Pebble	0.80	Run
02C	Ballpark Creek	60.98404	-149.49289	0.21	25–75	> 75	Cobble	0.28	Run
02D	Ballpark Creek	60.97987	-149.48239	—	—	—	—	—	Pond[c]
003	Unnamed	60.95877	-149.42762	0.05	> 75	> 75	Cobble	0.33	Run
004	Unnamed	60.95548	-149.42181	0.05	> 75	> 75	Cobble	0.35	Run
005	Unnamed	60.95201	-149.41108	0.09	> 75	> 75	Sand	3.00	Run
006	Unnamed	60.95191	-149.41109	0.07	< 25	< 25	Cobble	0.47	Run
007	Unnamed	60.95313	-149.41502	—	—	—	—	—	Pond[c]
08A	Unnamed	60.95164	-149.40853	—	—	—	—	—	Pond[c]
08B	Unnamed	60.95151	-149.40729	—	—	—	—	—	Pond[c]
09A	Unnamed	60.95158	-149.40306	—	—	—	—	—	Pond[c]
09B	Unnamed	60.95107	-149.39996	—	—	—	—	—	Pond[c]
09C	Unnamed	60.95053	-149.39802	—	—	—	—	—	Pond[c]

Note: m = meters; coordinates are in World Geodetic System 1984; all observations were made on September 28, 2023

[a] Bank angle increments: < 25 degrees, 25 to 75 degrees, < 75 degrees

[b] Observation made 10 m upstream to 10 m downstream of sampling location

[c] Only habitat type present; other observation categories not relevant

HDR captured anadromous fish at 8 of the 17 sampling locations. HDR submitted AWC nominations to ADF&G for waterbodies where more than one individual of the same anadromous species at the same life stage were captured. Table 3-2 lists AWC-nominated waterbodies within the Project area (01A and 004).

3.3 Fisheries Management Plan-Managed Species

Fish species with designated EFH in Turnagain Arm near the proposed Project area was identified with the National Oceanic and Atmospheric Administration (NOAA) Fisheries EFH Mapper in September 2024 and are included below (NOAA 2024). Dolly Varden is not managed under any FMP but are they described below because two streams within the Project area are listed as AWC and contain Dolly Varden.

3.3.1 Pacific Salmon

Pacific salmon are anadromous, being born in freshwater and generally spending most of their lives in saltwater before they return to their natal streams to spawn. Turnagain Arm provides EFH for five species of salmon: Chinook, chum, coho, sockeye and pink salmon.

3.3.1.1 Chinook Salmon

Chinook salmon rear in freshwater streams and estuaries. Alaska Chinook salmon tend to lay eggs between May and July. Eggs are deposited into redds and hatch during late winter or early spring. Alevins live within the gravel bed for several weeks, consuming their yolk sac before emerging as fry. Chinook smolts tend to leave for coastal waters either the year they hatch or the following year. Adult Chinook often return to their natal streams when they are 3 to 7 years of age for spawning (ADF&G 2023a).

Chinook salmon stocks throughout Alaska have exhibited declines and decreases in size of individuals at maturity. Additionally, younger age classes have become more predominant among spawning population. These trends are likely attributed to fishing pressures, environmental conditions, and competition and dietary restrictions associated with density-dependent interactions. These trends may result in declines in fitness, fecundity, and reproductive rates (Lewis et al. 2015).

On May 24, 2024, NOAA opened a 90-day petition finding to list the Gulf of Alaska Chinook Salmon, or any evolutionary significant unit that may exist within the petitioned area, as threatened or endangered under the Endangered Species Act and to designate critical habitat concurrent with the listing. The finding period was extended to end on September 6, 2024 (50 Code of Federal Regulations [CFR] 223 and 224). Chinook salmon of Turnagain Arm and its anadromous streams are included in the petition. A status review is being conducted on the Gulf of Alaska Chinook Salmon to determine if any evolutionary significant unit should be listed under the Endangered Species Act.

3.3.1.2 Coho Salmon

Spawning coho deposit their eggs in redds between July and November. The eggs develop and hatch as alevin during late winter or early spring. The alevins remain in the gravel bed feeding off their yolk sac before they emerge during May or June. Some fish leave their natal streams during spring to rear in coastal waters while others may spend up to 4 additional years predominately within freshwater systems (ADF&G 2023b). Return age data in the nearby Alaska Peninsula indicates most coho salmon returning to the region spend 1 to 3 years in freshwater followed by 1 year in saltwater. Commercial coho harvest in Upper Cook Inlet indicate the average size of individual coho is decreasing (Marston and Frothingham 2022).

3.3.1.3 Chum Salmon

Chum salmon are widely distributed throughout the Alaska. Chum spawn in a wide variety of habitats, including large muddy rivers; cold, clear headwater streams; and river mouths. Females lay eggs in redds, that will later hatch in 3 to 4 months. Alevins live off their yolk sac for up to 3 months before emerging from the gravel and making their way to the marine environment. Chum salmon fry use nearshore estuarine habitats as nursery grounds prior to leaving for open waters in the Pacific Ocean. Chum salmon feed off organic detritus and living plant material within nursery areas (Tuohy et al. 2019). They tend to return to their natal streams at 3 to 5 years of age and spawn during late summer and fall (ADF&G 2023c).

3.3.1.4 Pink Salmon

Pink salmon have strict 2-year lifespans, resulting in genetically separate stocks returning to the same streams from year to year. Eggs hatch during late winter or early spring and live off their yolk sac until they emerge as fry. Fry will quickly make their way to the ocean and begin their approximately 18-month period in saltwater. Pink salmon tend to return to freshwater between June and October. As with other Pacific salmon, female pink salmon build a redd where she lays her eggs, which are then fertilized by a male (ADF&G 2023d).

3.3.2 Alaska Plaice

Alaska plaice (*Pleuronectes quadrituberculatus*) distribution is primarily contained in the Chukchi Sea, Bering Sea, and northern Gulf of Alaska within habitats containing mixed sand and mud substrate (Matta 2012). During summer, adults tend to occupy deeper waters (less than 360 feet) while juveniles are found in more shallow, coastal areas. The Alaska plaice shift their distribution between warm and cold years. During warmer years, they position themselves in more northern waters and move to southern waters during colder years (Wilderbuer and Nichol 2019). Alaska plaice tend to reach maturity between 6 and 7 years of age and lay pelagic eggs that are dependent upon ocean currents to transport them to nursery areas. This typically occurs between April and June (Matta 2012).

3.3.3 Dover Sole

The Dover sole’s range spans from Southern Baja California in the south to the Bering Sea in the north. Adults occupy depths up to 1,440 feet during spawning events. Spawning season for the Dover sole along the Alaska coast takes place between January and August. The eggs are buoyant, and the larvae are planktonic. In their planktonic state, Dover sole can travel far distances by current transport (NPFMC 2024). After typically 1 year, but potentially up to 2 years, the Dover sole mature and settle to the ocean floor. Dover sole prefer soft substrates in deep water habitats (NPFMC 2024).

3.3.4 Flathead Sole

Flathead sole (*Hippoglossoides elassodon*) spawn during spring, with egg dispersal occurring over the eastern Bering Sea shelf between April and early July. The buoyancy of flathead sole eggs allows them to be transported by currents to nursery grounds within shallow inshore areas (Rooper et al. 2005). Adults occupy different locations seasonally between their winter spawning grounds and summertime feeding areas. During winter, flathead sole occupy shelf margins. The migration from the shelf margin to the middle and outer continental shelfs begins in April or May of each year for feeding. Breeding occurs on the outer continental shelf, primarily between April and May. Eggs hatch in 9 to 20 days and live off their yolk sac for an addition 6 to 17 days. After the yolk sac is depleted and prior to maturing from the larval state, the distribution of flathead sole is unknown. Juveniles occupy shallow nearshore nursery areas, with females most often reaching maturity prior to 9 years of age (Turnock et al. 2017).

3.3.5 Northern Rock Sole

Northern rock sole (*Lepidopsetta polyxystra*) is a flatfish with a range extending from Puget Sound, Washington, northward to the Bering Sea and Aleutian Islands, and westward to the Kuril Islands. Spawning occurs during winter and early spring. Northern rock sole migrate seasonally between spawning and feeding grounds. Female rock soles produce demersal egg masses that adhere to the substrate. Once they hatch, larval northern rock sole are pelagic and stay in deep waters up to 1,600 feet (Matta and Anderl 2012). In the Gulf of Alaska, females reach maturity at 7 years of age and live up to 18 years (Stark 2012; Lanksbury et al. 2007)

3.3.6 Yellowfin Sole

Yellowfin sole (*Limanda aspera*) is a flatfish that ranges from the coast of British Columbia, Canada (49 degrees North), to the Chukchi Sea (70 degrees North) and along the south Asian coast (35 degrees North). Adults move seasonally between spawning and feeding periods. Yellowfin sole occupy waters up to 330 feet deep, and travel to shallower waters to spawn between May and August. Upon hatching and settlement, juveniles seek out sediment suitable for feeding and burrowing protection (NPFMC 2024). Research in the Bering Sea suggests females reach sexual maturity by 10 years of age (TenBrink and Wilderbuer 2015).

3.3.7 Dolly Varden

The southern Dolly Varden's (*Salvelinus malma lordi*) range occurs between Southcentral Alaska and Washington state. Eggs incubate for 7 to 8 months before emerging during spring. Juveniles become smolt during early summer between 1 to 4 years of age (Krueger et al. 2011). After outmigration, Dolly Varden occupy nearshore environments. Adults undergo fall immigration into their natal, warmer, spring-fed tributaries before overwintering in lakes. Dolly Varden have been found dispersed across a wide range of freshwater system gradients, occupying spaces both above and below barriers to other anadromous fishes (Wissmar et al. 2009. Once Dolly Varden overwinter in a lake, they return to the same lake each winter (Jones et al. 1995). Juveniles feed primarily on winged insects and larvae, while adults prey on crustaceans, salmon eggs, insects, and small fish. Southern Dolly Varden reach maturity at 5 to 6 years of age but may live longer than 8 years (ADFG 2023e).

4 Analysis of Effects to EFH

The Proposed Action would impact both freshwater and marine EFH. Temporary and permanent EFH impacts would occur during both construction and operation of the Proposed Action. The following activities are most likely impact EFH:

- Culvert construction, extension, and removal
- Bridge construction
- Conversion to impervious roadway surface
- Stream realignments
- Marine fill

Mitigation measures and best management practices (BMPs) would be used under the Proposed Action to limit potential impacts on EFH and FMP-managed species. Additionally, culvert improvements would increase fish passage within some Proposed Action areas. Table 4-1 summarizes total impacts on EFH. All impacted habitat below the HTL is considered an impact on EFH. Construction and in-water work windows for culverts would be timed to minimize adverse effects to salmon during critical life stages. Construction windows would be planned through agency consultation and incorporated into all aspects of the Proposed Action for all in-stream work.

Table 4-1. Permanent and temporary impacts on EFH

Project Component	Permanent Impacts on EFH (acres)	Temporary Impacts on EFH (linear feet)[a]
Bridges	< 0.1	1,590
Culverts	0.2	505
Marine Fill	105.0	—
Total	**105.2**	**2,095**

[a] Impacts are based on the overall Project footprint. Temporary stream diversions may extend beyond the Proposed Action. Precise areas and length of stream EFH affected will be determined during final design.

4.1 Temporary Impacts

Construction of culverts, bridges, and roadway in addition to marine fill for the highway and railroad realignments would result in temporary impacts on EFH and FMP-managed species.

4.1.1 Culverts

The replacement of culverts would require temporary modifications to EFH such as modifications within drainage areas or removal of riparian vegetation within the immediate vicinity. It may be necessary to remove sections of riverbank habitat to replace culverts. Culvert replacements will be further evaluated following geotechnical investigations within the Project area to better identify subsurface conditions. Ten culvert replacements or extensions would occur within anadromous streams.

Culvert construction could be harmful to eggs or alevin present in the streambed, increasing turbidity, creating instream scour, and resulting in siltation. Substrate disturbance, streambank excavation, and shoreline erosion during construction would cause increased siltation and turbidity. Increased turbidity could affect fishes' ability to forage and seek shelter at the disturbance location and downstream (Reudiger and Reudiger 1999). Increased siltation could affect respiratory function of FMP-managed fish or reduce interstitial flow in gravels, suffocating eggs.

Culvert construction would result in modifications to drainage areas. While temporary stream diversions would allow for continued fish passage within each creek, they temporarily impair habitat function. Additionally, dewatered areas containing spawning gravels would be lethal to eggs or alevin if present within the dewatering area. ADF&G will review and approve stream diversion techniques prior to construction. Impacts would be minimized by conducting culvert construction during times of the year when crucial life stages of salmon are less prevalent and installing stream diversions. An Aquatic Resources Permit would be obtained prior to culvert construction and allow the contractor to remove fish from dewatering areas, limiting potential impacts on rearing fish.

To access culverts and grade streambanks, vegetation would have to be removed from riparian areas. When riparian vegetation is removed, it makes streams more exposed to the surrounding environment. Increased exposure to the surrounding environment can result in both physical and biological impacts. Removing vegetation canopy above streams reduces shading to the stream, potentially increasing stream water temperatures. Vegetation removal reduces the available large woody debris available surrounding a stream. This limits the potential for large woody debris to enter waterbodies and create foraging and sheltering habitat for juvenile fish. Vegetation removal also changes the way nutrients are inputted into receiving waters (USACE 2015; Peterson and Lowe 2009). Reductions in tree cover would reduce shading and may make some fish more susceptible to predation from terrestrial predators.

Riparian areas would be reseeded after construction and are expected to return to pre-construction conditions in the short term. Most construction activities would occur within current Seward Highway clearing limits, except for highway segments that would be vertically separated, leaving few places where riparian vegetation removal would be needed. The limited riparian vegetation removal needed for construction is not anticipated to be substantial enough to have noticeable adverse effects associated with stream water temperature increases, reduction of large woody debris, and reduction of prey and nutrients.

4.1.2 Bridges

No structures would be placed below the HTL at Indian Creek. The bridge at Bird Creek would be supported by in-water piers. In-water piers would be driven into the substrate by impact or vibratory hammers. The use of impact or vibratory hammers would be determined during final design.

Fish detect sound using an inner ear that is sensitive to particle motion. Interfering with the inner ear's ability to function may affect a fish's ability to communicate, detect prey and predators, navigate, and select appropriate habitats. Salmon swim bladders do not have a function in their hearing and are sensitive to only a narrow band of frequencies. Fish farther from the pressure source may be deterred from the area.

The use of vibratory and impact hammers results in the dispersal of underwater pressure waves. When fish are close to the impact location and subject to pressure waves, they may display a negative response such as rupturing of swim bladders or internal hemorrhaging. These impacts are often lethal. Underwater sound pressures can also affect fishes' ability to hear. Sound waves traveling through substrates have the potential to be more impactful than those that propagate through the water column. Similar, physically damaging effects from sound pressure waves have been documented in eggs and alevin in spawning substrate close to the impact location. Vibratory hammers are known to be less impactful than impact hammers and are often the preferred installation method to reduce impacts on fish. However, vibratory hammers may be more disruptive to sediment fines and cause eggs to be smothered (Stadler 2003; Caltrans 2020). In-water work for pier installation may also incur the same temporary turbidity, siltation, and scour impacts discussed in Section 4.1.1.

Vegetation may need to be removed to construct each bridge. Vegetation removal impacts and revegetation expectations are discussed in Section 4.1.1.

4.1.3 Roadway

As with culvert and bridge construction, roadway construction would require vegetation removal. Vegetation removal along roadways allows for more rapid concentration of precipitation, higher flow rates, and increased potential for erosion. Increased erosion from construction may result in excess nutrients entering waterways and impacting water quality. Changes to water quality from nutrient additions are known to impact biological growth and may result in increased vegetation competition and habitat change. Runoff from construction areas may also contain hazardous materials and act as a vector for pollution to enter waterways. Additionally, removal of topsoil for the roadway may result in reduced nutrients to terrestrial plants and alter riparian growth (FHWA 2015).

BMPs would be implemented to reduce the potential for runoff and erosion impacts. The contractor would prepare a Spill Prevention, Control, and Countermeasure (SPCC) Plan to address any potential hazardous spills. Erosion control measures would be put in place to reduce erosion potential and sediment entering EFH. Additionally, most equipment fueling would occur at least 100 feet from waterbodies, limiting the potential for hazardous runoff.

Blasting would occur in places where rock cannot be excavated during construction. In accordance with 11 Alaska Administrative Code 95.335, blasting operators would limit the amount of fly rock materials deposited into fish bearing waters. Blasting would occur between 250 and 380 feet of Little Survival Creek, Potter Creek, Potter Creek Middle Fork, and Potter Creek South Fork. Blasting would occur at least 1,000 feet from all other AWC waterbodies. Due to the distance from blasting, fly rock is not anticipated to enter EFH. This is particularly true for Rabbit Creek, McHugh Creek, Unnamed Creek, Indian Creek, Bird Creek, Birdhouse Creek, and Unnamed Creek at MP 99.5. If it were to enter EFH, it would likely only be small particles. Blasting would occur at low tide, limiting blasting proximity to marine waters. Due to the distance of blasting from EFH, fly rock and blasting debris are not anticipated to affect EFH and FMP-managed species.

4.1.4 Stream Realignment

The culvert at Potter Creek would contain the three forks within a singular culvert for approximately 40 feet. Approximately 800 linear feet of Potter Creek would be rerouted to maintain access to headwaters outside the Proposed Action footprint.

Fill would be placed in the uppermost 110 feet of Birdhouse Creek's AWC component to support the highway embankment. A new stream channel would be excavated outside the fill limits to maintain fish passage under the pedestrian walking trail.

If eggs have been deposited within areas proposed to be dewatered, they would likely die. Coho salmon rear in Birdhouse Creek and the three Potter Creek forks, while pink salmon have been identified in the upper reaches of Potter Creek. Given the long freshwater residency for coho salmon, juveniles would likely be present year-round during construction. Erosion from channel reconstruction and substrate, including fines deposited onto the substrate prior to watering the channel, may cause siltation and increase turbidity within the systems. Siltation and turbidity impacts are discussed in Section 4.1.1. Until the stream is established and stream processes occur, newly formed channels may initially lack specific habitat such as large, woody debris.

Temporary impacts from channel reconstruction are anticipated to be minor. At all locations where AWC waterbodies are reconstructed, they would be contoured to mimic representative upstream channel conditions. Fish would be removed from proposed fill locations prior to dewatering. Substrate added for the new stream segments would be locally sourced and sized to match substrate in a representative upstream location. Additional surveys and design would occur prior to construction to determine the exact location of the new channel. A small amount of flow would be diverted in the new channel to wash fines into the substrate prior to diverting all the stream's flow. This would limit potential impacts on fish by maintaining fish passage in each creek throughout construction and reducing siltation and turbidity potential.

4.1.5 Marine Fill

Fill placement within the marine environment would result in a temporary increase in turbidity within the Turnagain Arm. The fine sediment composing Turnagain Arm's substrate, combined with extreme tides and headwaters carrying high sediment loads, make Turnagain Arm highly turbid (USFWS 2004; DeBoer 2007). As such, turbidity impacts are anticipated to be negligible and short term. Fill would be placed within the marine environment at low tide to the greatest extent possible.

Flatfish eggs are planktonic, and subject to tides and currents for movement. Flatfish larvae are poor swimmers and still subject to environmental factors for dispersal. Currents and wind carry larval flatfish to their juvenile nursery grounds. Larval supply within an area is often related to juvenile density in many species. This relationship varies by species, scale, and juvenile behavior (Able and Fodrie 2014; Bailey et al. 2004).

Norcross (1995) found juvenile flatfish in Kachemak Bay displaying a strong preference for nurseries with certain depths that contain specific substrates. The flatfish captured during the study were flathead, dover, yellowfin, and rock sole. Flatfish less than 1 year of age were predominately found occupying depths of 20 to 65 feet in sand, muddy sand, and gravelly mud substrates.

Turnagain Arm is primarily composed of fines, and much of it is dry at low tide. Additionally, it is geographically restricted and not suitable habitat for plankton transiting to other suitable environments. Based on the Norcross (1995) study, the Proposed Action area would not be suitable nursery habitat for flathead, dover, yellowfin, and rock sole. As a result, densities of larval and juvenile flatfish are anticipated to be low to absent within the area.

Given the lack of suitable juvenile nursery habitat surrounding the Proposed Action, FMP-managed flatfish eggs and larvae are not anticipated to be present and not likely to be directly affected during construction or operation of the Proposed Project.

4.2 Permanent Impacts

Permanent impacts on EFH and FMP-managed species would occur from the placement of piers to construct the bridges at Bird Creek, replacement and extension of 10 culverts or flood relief pipes, reconstruction of channels, construction of the highway and railroad embankments, and operation of the highway.

4.2.1 Culverts

Culverts installed under the Proposed Action may alter stream velocity and sediment transport. Sediment transport has the potential to reduce the quality of spawning habitat as fines reduce interstitial flow downstream of in-water structures (Reudiger and Reudiger 1999). Each culvert would be further evaluated following geotechnical investigations and additional design to minimize or avoid these impacts. Many existing culverts within the project area are in very poor condition, are severely eroded, and do not effectively pass fish. Replacing these culverts would facilitate fish movement into EFH.

Where culverts are extended, a minimal increase in shading of EFH would occur. Light availability influences photosynthesis of phytoplankton and algae, two important components of the food web for juvenile salmon. Shaded areas are also known to cause minor delays in fish migration and cause juvenile salmon to seek deeper waters during daylight, exposing them to predation by larger fish.

4.2.2 Bridges

Aquatic vegetation is often scarce in waters beneath bridges due to the lack of light and growing potential (Stallings et al. 2014). The addition of piers below the HTL has the potential to alter localized stream velocity and affect sediment transport. Section 4.2.1 discusses light reduction, stream velocity, and sediment transport impacts. A minimal loss of EFH would occur from the placement of piers within Bird Creek to support the highway and railroad bridges.

4.2.3 Roadway

Widening the highway would increase the overall impervious surface and may decrease ground infiltration potential. Runoff from impervious surfaces is the most widespread source of pollution into the nation's waterways. Runoff may contain pollutants such as construction sediment, car exhaust, vehicle oil, and inorganic and organic contaminants (Peterson and Lowe 2009). Sediment runoff increases the total suspended solids and turbidity in a system, while other pollutants often lead to other forms of water quality degradation. The width of the highway expansion has been minimized as much as practicable and levels of these pollutants entering EFH is not expected to substantially increase from construction of the Project.

Road widening would add additional pavement, which would result in the conversion to impervious substrate and alter groundwater infiltration potential. However, given the proximity of the road alignment to Turnagain Arm and limited spaces surrounding the Seward Highway that are impervious surfaces, the Proposed Action is not expected to create adverse impacts associated with groundwater infiltration potential reduction. The approved SPCC Plan and erosion controls would limit the potential for pollutants and contaminates entering waterbodies as well as potential erosion effects.

4.2.4 Stream Realignment

Channel reconstruction would permanently move approximately 800 feet of channel at Potter Creek, 40 feet at Potter Creek South Fork, and 110 feet at Birdhouse Creek. BMPs would be established to retain stream function and mimic existing conditions (Section 4.1.4). Permanent impacts on EFH and FMP-managed species from channel reconstruction are anticipated to be minor since Project stream realignments would allow fish to move into EFH more effectively in many cases due to the poor condition of many existing culverts.

4.2.5 Marine Fill

The Proposed Action will convert 105 acres of marine EFH to uplands to support the highway and railroad embankments. Fill within Turnagain Arm that alters the shoreline has the potential to change reflective wave energy. This could accelerate the natural movement of shoreline substrates and change both intertidal and subtidal habitats. However, the Proposed Action would create embankments of over time, the proposed fill embankments are likely to result in similar shoreline and nearshore habitats that are currently found adjacent to the existing railroad embankment. Wave action is not anticipated to be dissimilar to current conditions that it would have a noticeable effect on aquatic biota.

4.3 Cumulative Effects

Cumulative effects are impacts on the environment that result from the incremental impacts of an action when added to other past, present, and reasonably foreseeable future actions (40 CFR 1508.7). A cumulative effects analysis is intended to examine actions occurring within a watershed or marine ecosystem that adversely affect the ecological structure or function of EFH.

Existing facilities within the Proposed Project area include: Chugach State Park; the Seward Highway; the railroad embankment; various utilities (gas, fiber optic, electric); multiple turnouts/pullouts; multiple trails (paved and unpaved); and the communities of Rainbow, Indian, and Bird. Routine maintenance of existing facilities includes removal of trash and clearing of vegetation within right-of-way and utility corridors.

Currently, a sign upgrades project between MP 116.5 and 94.6 is planned to increase size and readability of signs and repair speed feedback signs. This project would add milepost markers in the pullouts so people calling for emergency services correctly identify their location. It would also add additional signs in advance of pullouts/recreational signs to improve wayfinding.

Reasonably foreseeable future actions include:

- Rockfall maintenance (MPs 113.5 to 112.5) would be conducted as needed due to natural occurrence.
- The McHugh Creek Turn Lane project would construct left-turn and acceleration lanes at McHugh Creek (MPs 112.5 to 111).
- The Alaska Department of Natural Resources is proposing to construct boardwalk and viewing platforms at the northern end of Potter Marsh as well as a boardwalk/viewing platform and winter access at the southern end of Potter Marsh.

The Potter Marsh boardwalk would likely be placed within waters designated as EFH. Impacts from the remaining projects are anticipated to occur outside of EFH. If constructed, the new boardwalk at Potter Marsh would be on the southern end of Potter Marsh and not close to EFH that the Proposed Action would potentially affect.

5 Proposed Conservation Measures

Proposed conservation measures listed below are a part of the project description. DOT&PF intends to work with NMFS and ADF&G during project permitting to implement conservation measures and minimize impacts to fish and EFH. Impacts on EFH would be minimized through the use of construction BMPs and the following conservation measures:

- Engineering design will place as few piers as possible in EFH below OHW.
- Pile driving activities may be limited to late October through December to avoid impacts on spawning fish.
- Construction and in-water work windows will be timed to minimize adverse impacts on salmon during critical life stages. Windows of construction will be planned through agency consultation and incorporated into all aspects of the Project for in-stream work.
- Construction activities will not result in migration barriers to adult or juvenile salmon.
- Contaminant-free embankment and surface materials will be used in construction.
- Streambanks where culverts and bridges would be replaced will be recontoured and revegetated with native vegetation to minimize erosion and provide fish habitat.
- Streams that lie within the proposed footprint will be rerouted to ensure connectivity within freshwater EFH.
- Staging areas will be located within uplands or previously disturbed areas.
- The contractor will place fill material and riprap below OHW during periods of low flow.
- The contractor will be required to have an approved Stormwater Pollution Prevention Plan. This plan will clearly describe BMPs required during construction to prevent erosion and runoff from entering aquatic habitats.
- The contractor will prepare an approved Spill Prevention, Control, and Countermeasures Plan for the Project. Standard spill-prevention measures will be implemented during construction. Spill clean-up equipment (e.g., oil-absorbent pads) will be available on-site during construction.
- No vehicles or equipment will be fueled or serviced within 100 feet of wetlands or fish-bearing streams, except for “low-mobility” equipment used for pile driving, drilled shaft construction, or other bridge construction. An appropriate plan will be developed detailing the fueling process for this equipment and materials to immediately contain and clean up spilled petroleum products. Fuel will be stored a minimum of 100 feet from any waterbody or wetland.
- Appropriate erosion and sediment control measures (e.g., silt fences, vegetative buffers) will be implemented to minimize transport of sediment to Waters of the United States, and disturbed areas will be seeded with a seed mixture recommended by the Alaska Department of Natural Resources to provide vegetation stabilization in accordance with the *Revegetation and Invasive Species Management Plan*.
- All sediment control measures (e.g., silt curtains, certified weed-free straw wattles, other structures) will be properly installed and maintained in a functioning manner for the duration of the Project.
- Existing drainage patterns will be maintained or enhanced wherever possible, including replacement of damaged or failing culverts with pipes of equal or larger size.

6 Agency Determination

Based on the scope and nature of impacts expected from the Project and the conservation measures put in place to minimize impacts, DOT&PF has determined that temporary and permanent effects to EFH would occur from construction of the Project. Culvert replacements and stream realignments would affect EFH but overall increase stream connectivity and fish access to EFH. Marine fill to realign the highway and railroad embankments would permanently remove a minor amount of EFH relative to the amount found in Turnagain Arm. DOT&PF intends to work with ADF&G and NOAA throughout the Project's permitting process to correctly implement conservation measures and minimize impacts.

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Appendix A. Freshwater EFH

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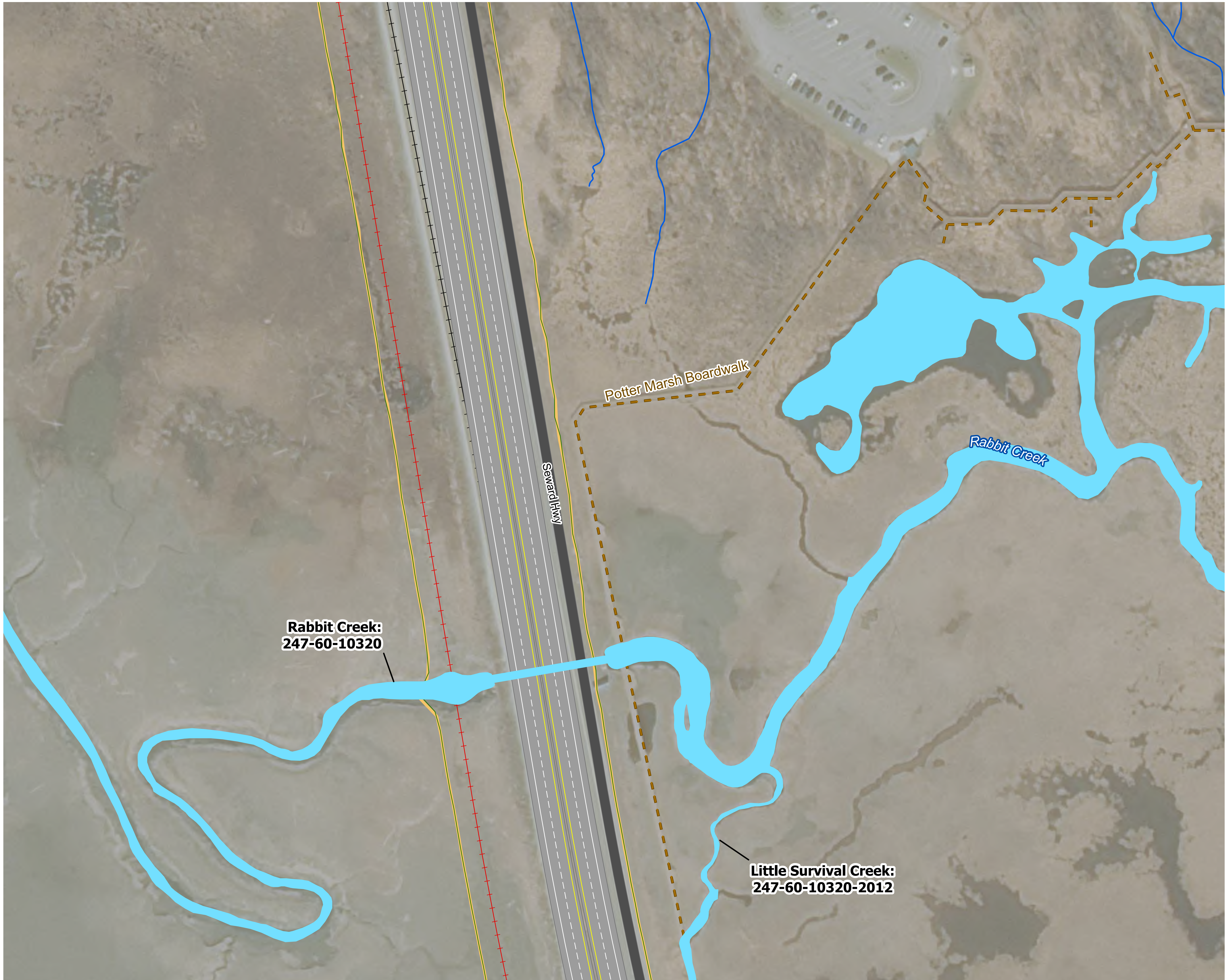
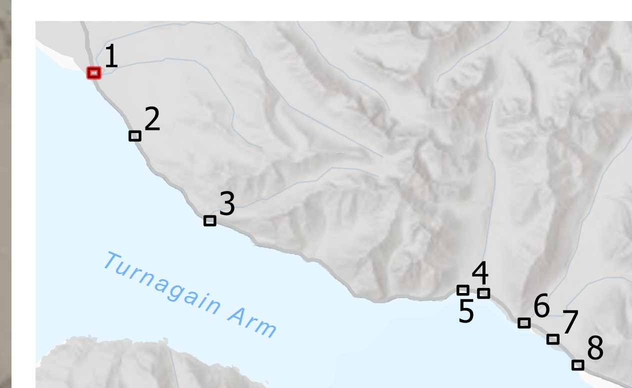
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 1:Rabbit Creek



- EFH - Anadromous Stream
- Freshwater Stream
- Fill
- New Railroad
- Existing Railroad
- Road Pavement
- Path
- Project Footprint
- Trail or Pathway

Essential fish habitat for the following fisheries management plan species:
Rabbit Creek: Coho (Spawning and Rearing), Chinook (Spawning and Rearing), Chum (Presence), Pink (Spawning), and Sockeye (Presence)
Little Survival Creek: Coho (rearing) and Chinook (rearing)



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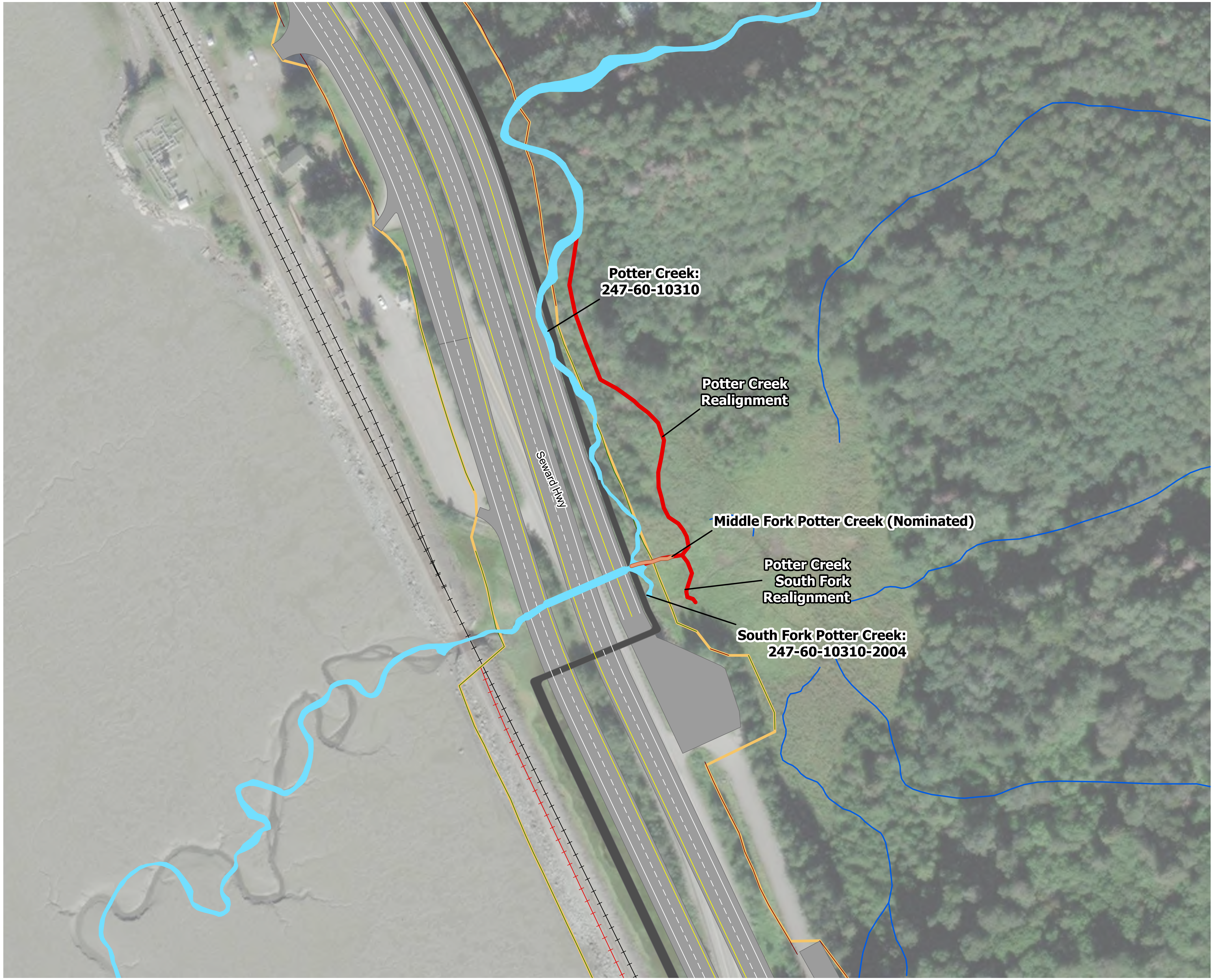
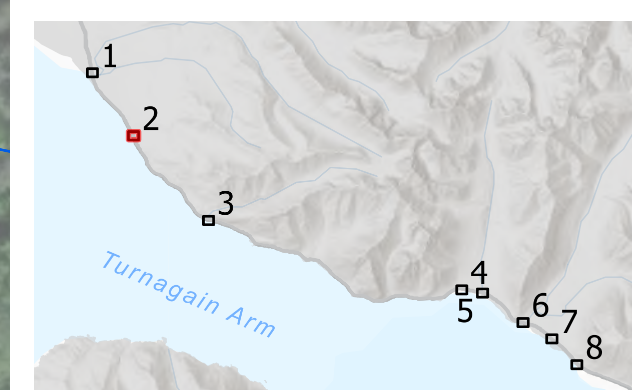
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 2:Potter Creek



- EFH - Anadromous Stream
- Potter Creek Re-Alignment
- Nominated Anadromous Stream
- Freshwater Stream
- Cut
- Fill
- New Railroad
- Existing Railroad
- Road Pavement
- Path
- Project Footprint

Essential fish habitat for the following fisheries management plan species:
Potter Creek: Coho (Rearing) and Pink (Presence)
Middle Fork Potter Creek: Coho (Rearing)
South Fork Potter Creek: Coho (Rearing)



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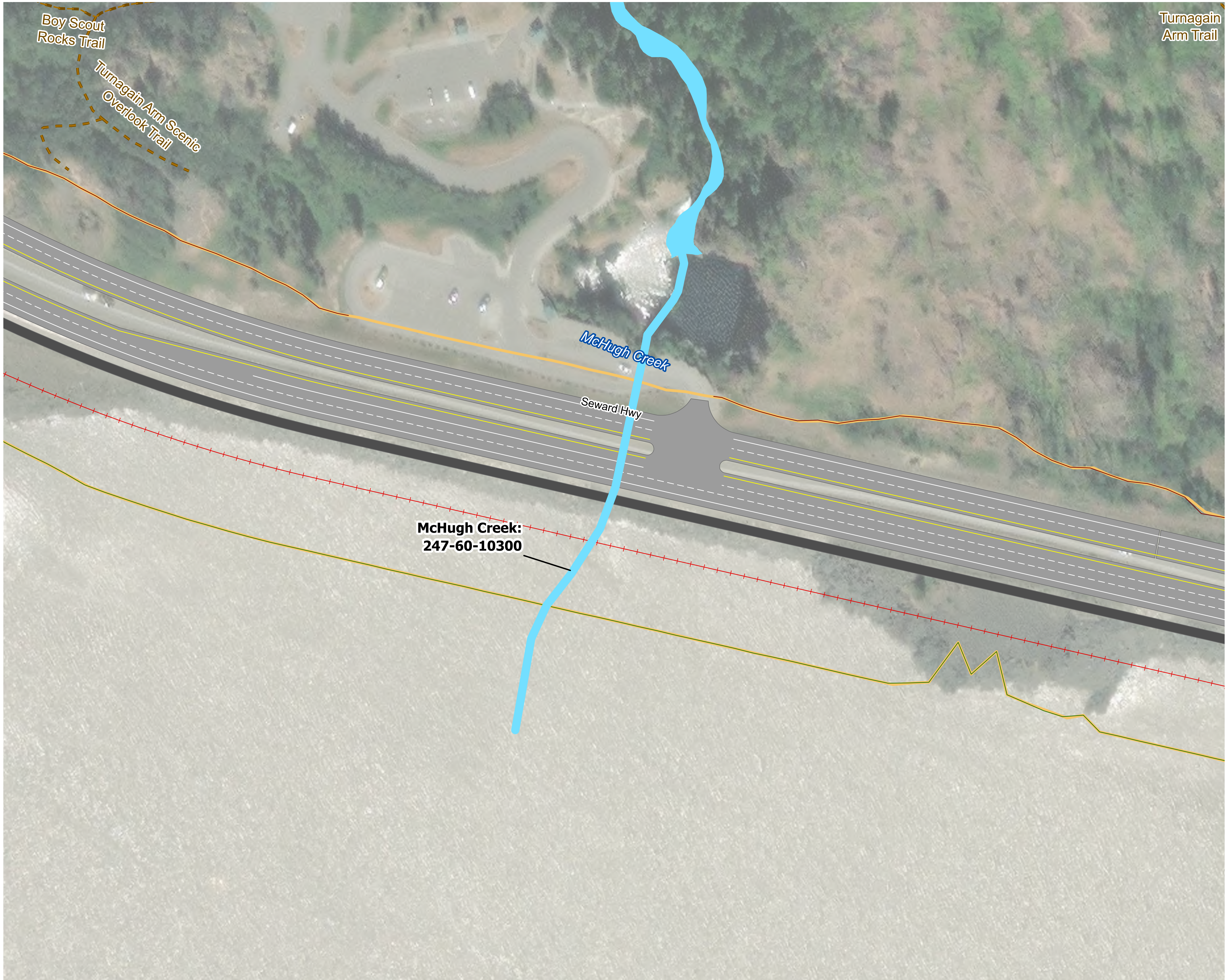
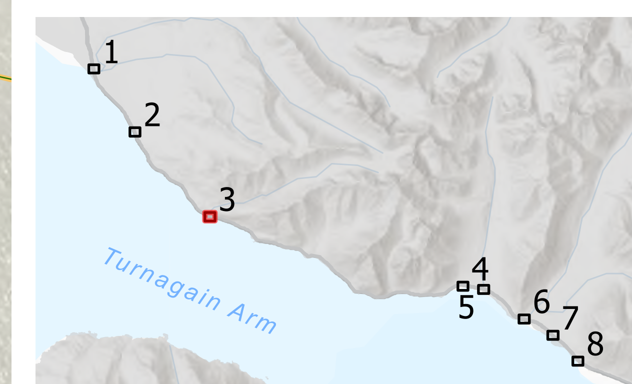
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 3:McHugh Creek



- EFH - Anadromous Stream
- Freshwater Stream
- Cut
- Fill
- New Railroad
- Existing Railroad
- Road Pavement
- Path
- Project Footprint
- Trail or Pathway

Essential fish habitat for the following fisheries management plan species:
Coho (Rearing)



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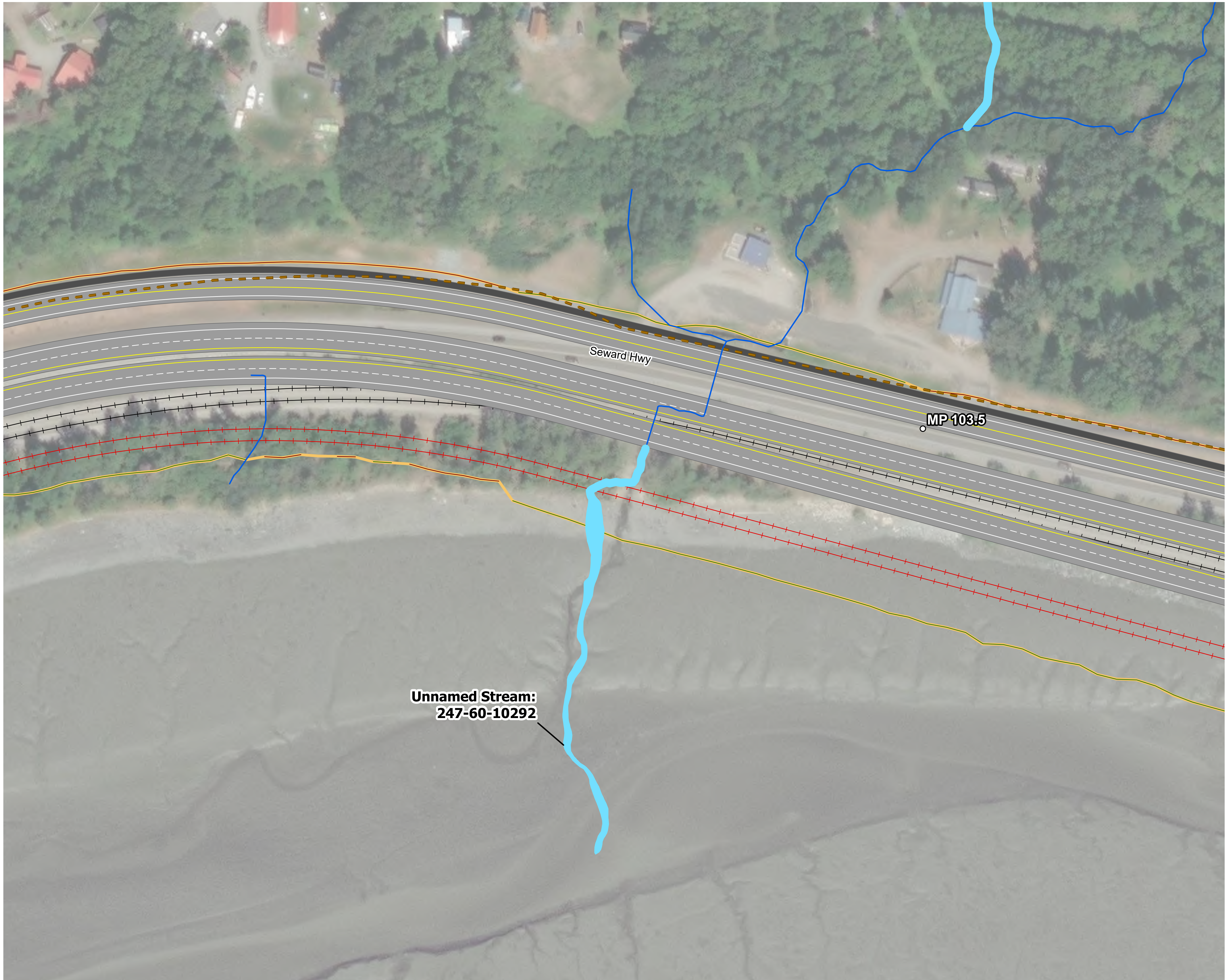
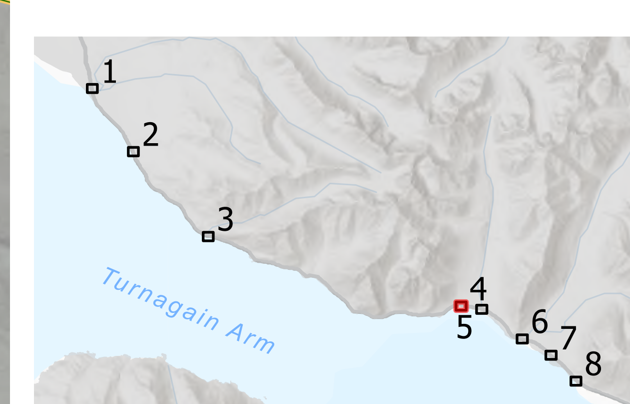
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 4:Unnamed Creek 247-60-10292



EFH - Anadromous Stream
Mileposts
Freshwater Stream
Cut
Fill
New Railroad
Existing Railroad
Road Pavement
Path
Project Footprint
Trail or Pathway

Essential fish habitat for the following fisheries management plan species:
Coho (Rearing)



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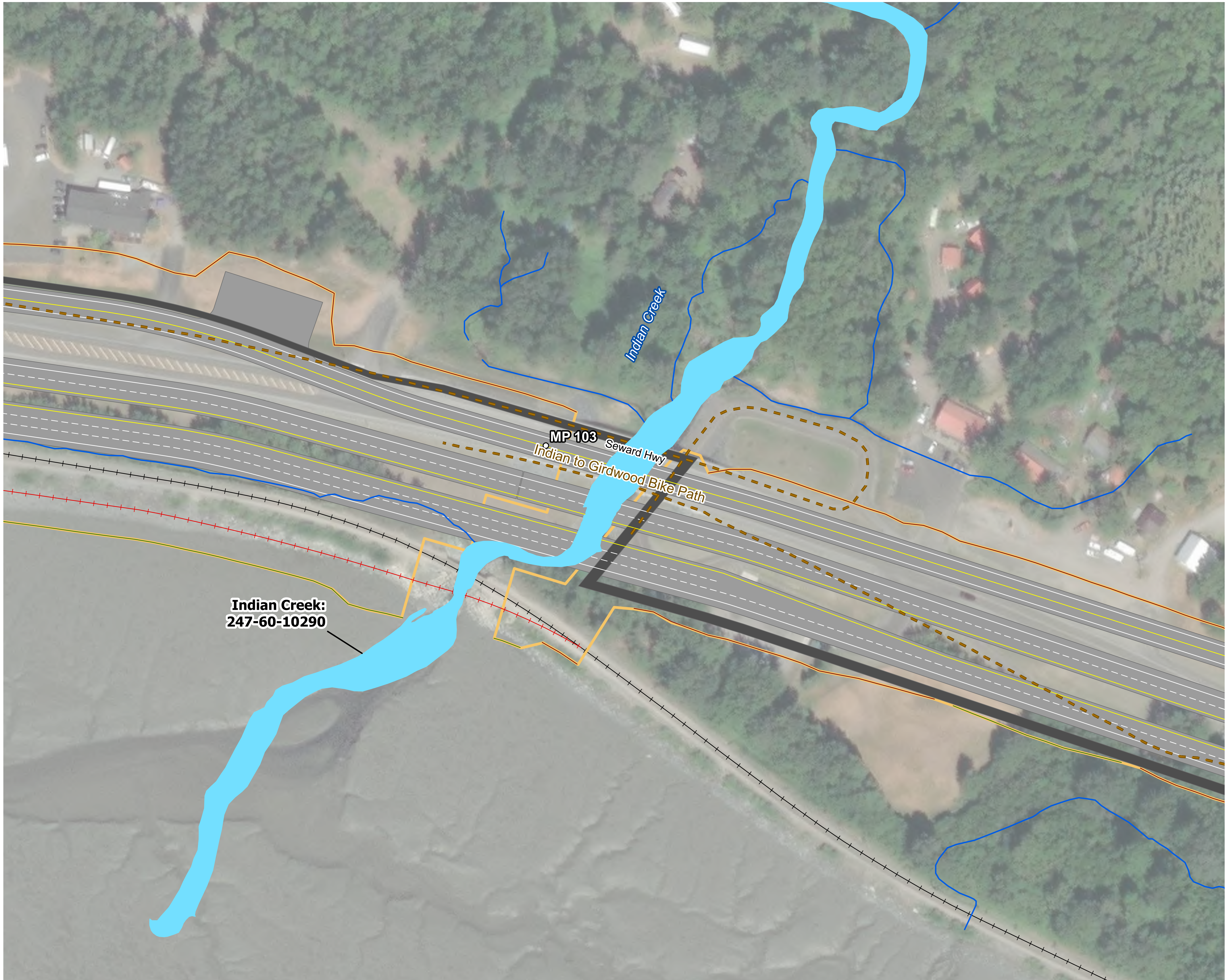
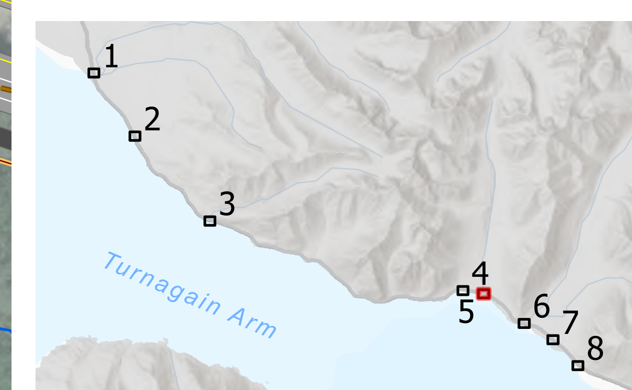
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 5:Indian Creek



- EFH - Anadromous Stream
- Mileposts
- Freshwater Stream
- Cut
- Fill
- New Railroad
- Existing Railroad
- Road Pavement
- Path
- Project Footprint
- Trail or Pathway

Essential fish habitat for the following fisheries management plan species:
Coho (Rearing and Presence), Chinook (Presence), and Pink (Spawning and Presence)



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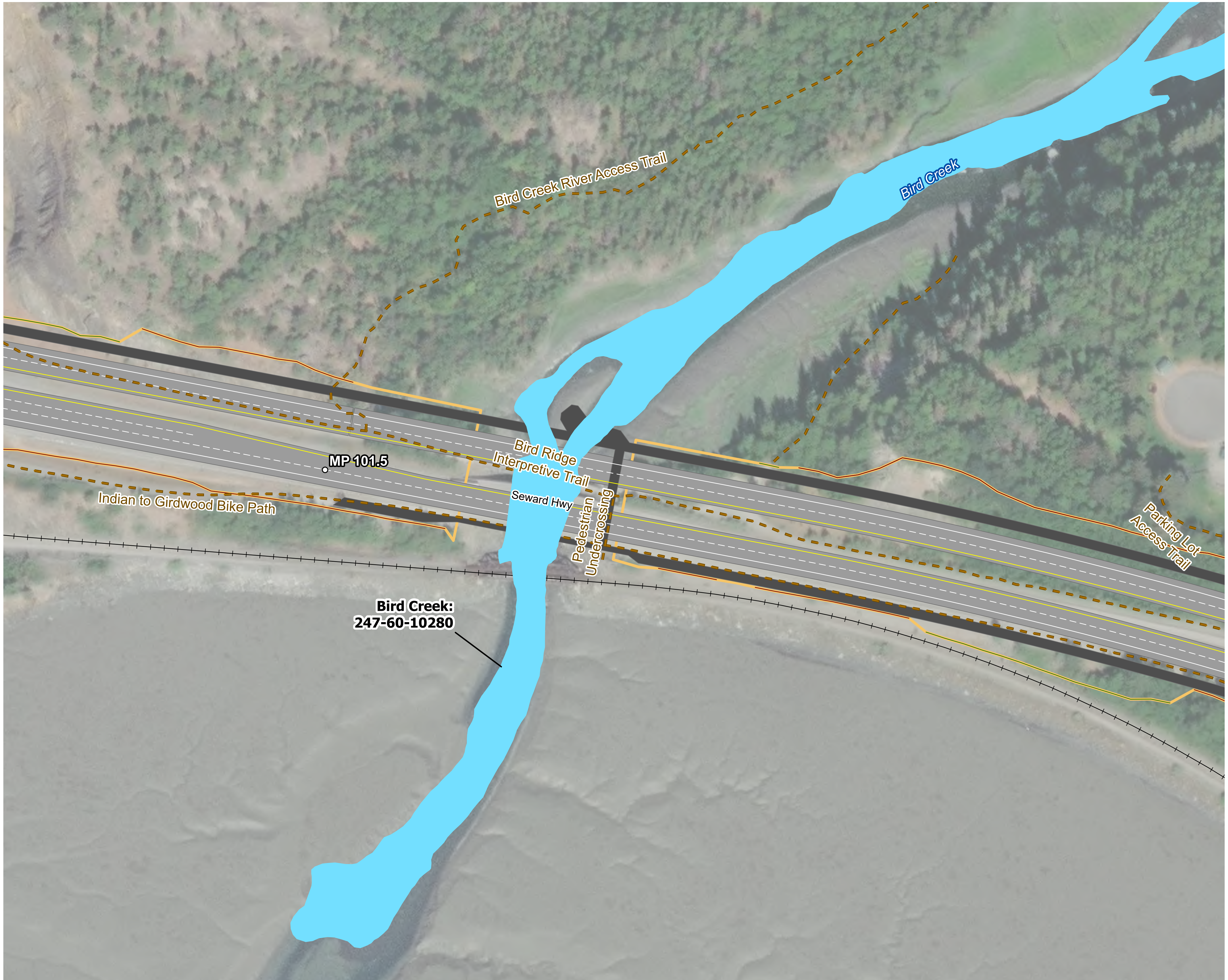
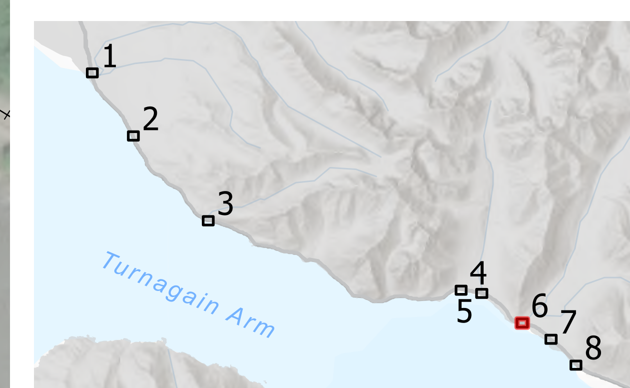
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 6:Bird Creek



- EFH - Anadromous Stream
- Mileposts
- Freshwater Stream
- Cut
- Fill
- Existing Railroad
- Road Pavement
- Path
- Project Footprint
- Trail or Pathway

Essential fish habitat for the following fisheries management plan species:
Coho (Spawning and Presence), Chinook (Spawning and Rearing), Chum (Spawning), and Pink (Spawning)



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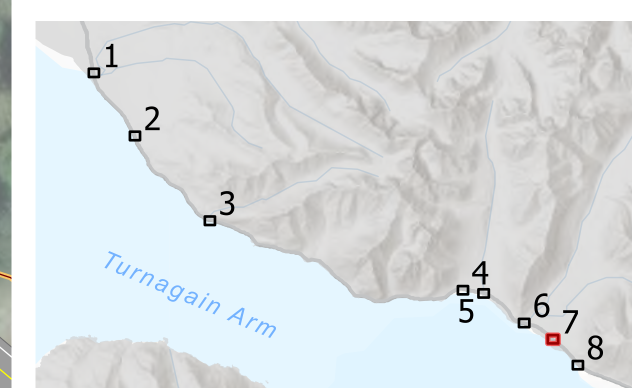
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 7:Birdhouse Creek

- EFH - Anadromous Stream
- Birdhouse Creek Re-Alignment
- Mileposts
- Freshwater Stream
- Cut
- Fill
- Existing Railroad
- Road Pavement
- Path
- Project Footprint
- Trail or Pathway

Essential fish habitat for the following fisheries management plan species:
Coho (Rearing)



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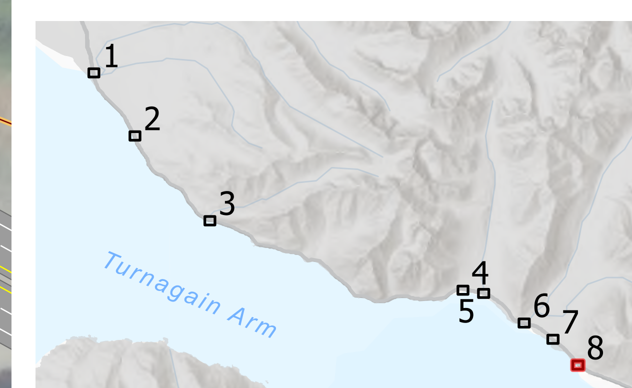
Seward Highway
Essential Fish Habitat
Anadromous Waterbodies
Figure 8:Unnamed Creek MP 99.5

- EFH - Anadromous Stream
- Nominated Anadromous Stream
- Mileposts
- Freshwater Stream
- Cut
- Fill
- Existing Railroad
- Road Pavement
- Path
- Project Footprint
- Trail or Pathway

Essential fish habitat for the following fisheries management plan species:
Coho (Rearing)



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Appendix B. Marine EFH

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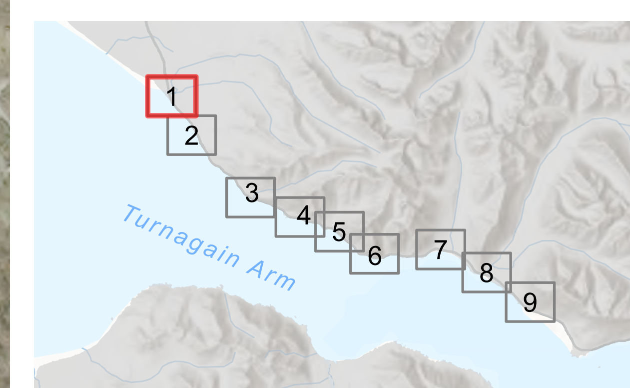
Seward Highway
Marine Habitat Impacts
Figure 1 of 9

Mileposts
High Tide Line
Marine Impacts Below HTL
Project Footprint

Essential fish habitat for the following fisheries management plan species:
Alaska Plaice and Rex Sole (egg and larvae); Dover Sole, Flathead Sole, Northern Rock Sole, Southern Rock Sole, and Pacific Cod (larvae); Yellowfin Sole (egg); Coho, Chinook, Chum, Pink, and Sockeye Salmon (estuarine and marine juvenile and marine immature and maturing adult)



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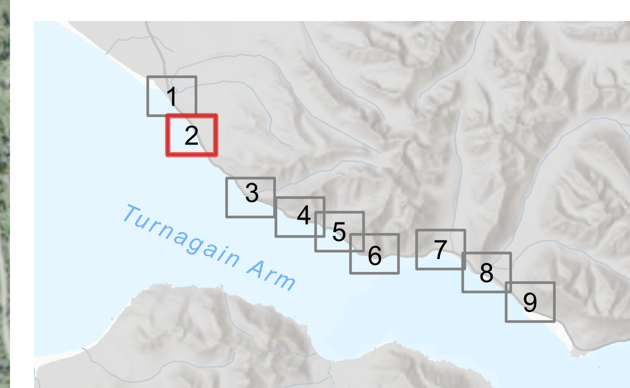
Seward Highway
Marine Habitat Impacts
Figure 2 of 9

- Mileposts
- High Tide Line
- Marine Impacts Below HTL
- Project Footprint

Essential fish habitat for the following fisheries management plan species:
Alaska Plaice and Rex Sole (egg and larvae); Dover Sole, Flathead Sole, Northern Rock Sole, Southern Rock Sole, and Pacific Cod (larvae); Yellowfin Sole (egg); Coho, Chinook, Chum, Pink, and Sockeye Salmon (estuarine and marine juvenile and marine immature and maturing adult)



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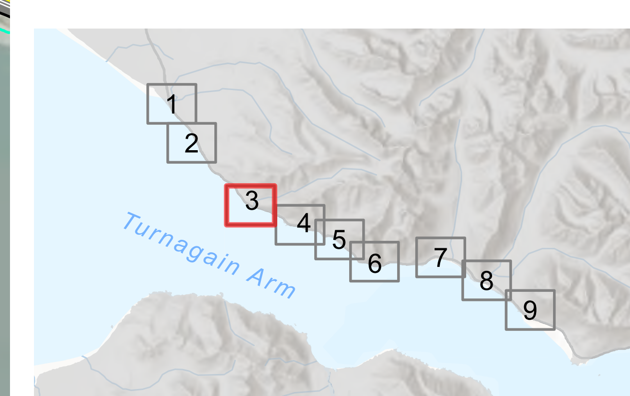
Seward Highway
Marine Habitat Impacts
Figure 3 of 9

- Mileposts
- High Tide Line
- Marine Impacts Below HTL
- Project Footprint

Essential fish habitat for the following fisheries management plan species:
Alaska Plaice and Rex Sole (egg and larvae); Dover Sole, Flathead Sole, Northern Rock Sole, Southern Rock Sole, and Pacific Cod (larvae); Yellowfin Sole (egg); Coho, Chinook, Chum, Pink, and Sockeye Salmon (estuarine and marine juvenile and marine immature and maturing adult)



SAFER Seward Highway

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Seward Highway
Marine Habitat Impacts
Figure 4 of 9

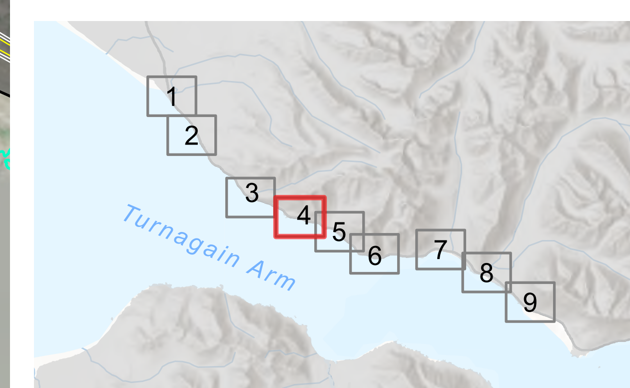
Mileposts

High Tide Line

Marine Impacts Below HTL

Project Footprint

Essential fish habitat for the following fisheries management plan species:
Alaska Plaice and Rex Sole (egg and larvae); Dover Sole, Flathead Sole, Northern Rock Sole, Southern Rock Sole, and Pacific Cod (larvae); Yellowfin Sole (egg); Coho, Chinook, Chum, Pink, and Sockeye Salmon (estuarine and marine juvenile and marine immature and maturing adult)



SAFER Seward Highway

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Seward Highway
Marine Habitat Impacts
Figure 5 of 9

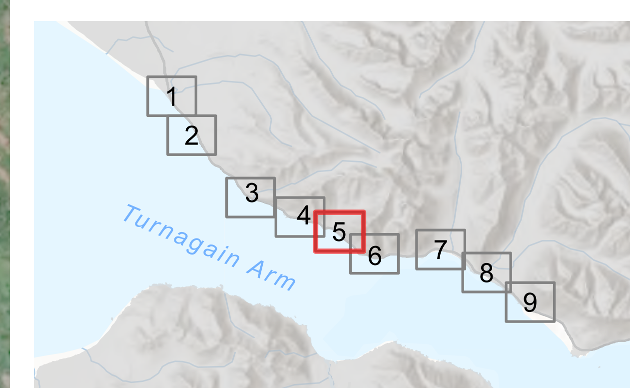
Mileposts

High Tide Line

Marine Impacts Below HTL

Project Footprint

Essential fish habitat for the following fisheries management plan species:
Alaska Plaice and Rex Sole (egg and larvae); Dover Sole, Flathead Sole, Northern Rock Sole, Southern Rock Sole, and Pacific Cod (larvae); Yellowfin Sole (egg); Coho, Chinook, Chum, Pink, and Sockeye Salmon (estuarine and marine juvenile and marine immature and maturing adult)



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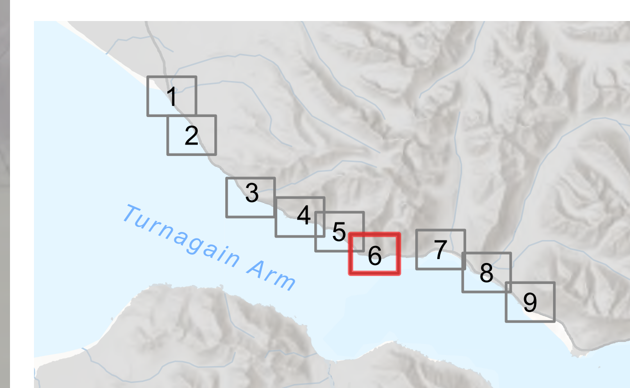
Seward Highway
Marine Habitat Impacts
Figure 6 of 9

- Mileposts
- High Tide Line
- Marine Impacts Below HTL
- Project Footprint

Essential fish habitat for the following fisheries management plan species:
Alaska Plaice and Rex Sole (egg and larvae); Dover Sole, Flathead Sole, Northern Rock Sole, Southern Rock Sole, and Pacific Cod (larvae); Yellowfin Sole (egg); Coho, Chinook, Chum, Pink, and Sockeye Salmon (estuarine and marine juvenile and marine immature and maturing adult)



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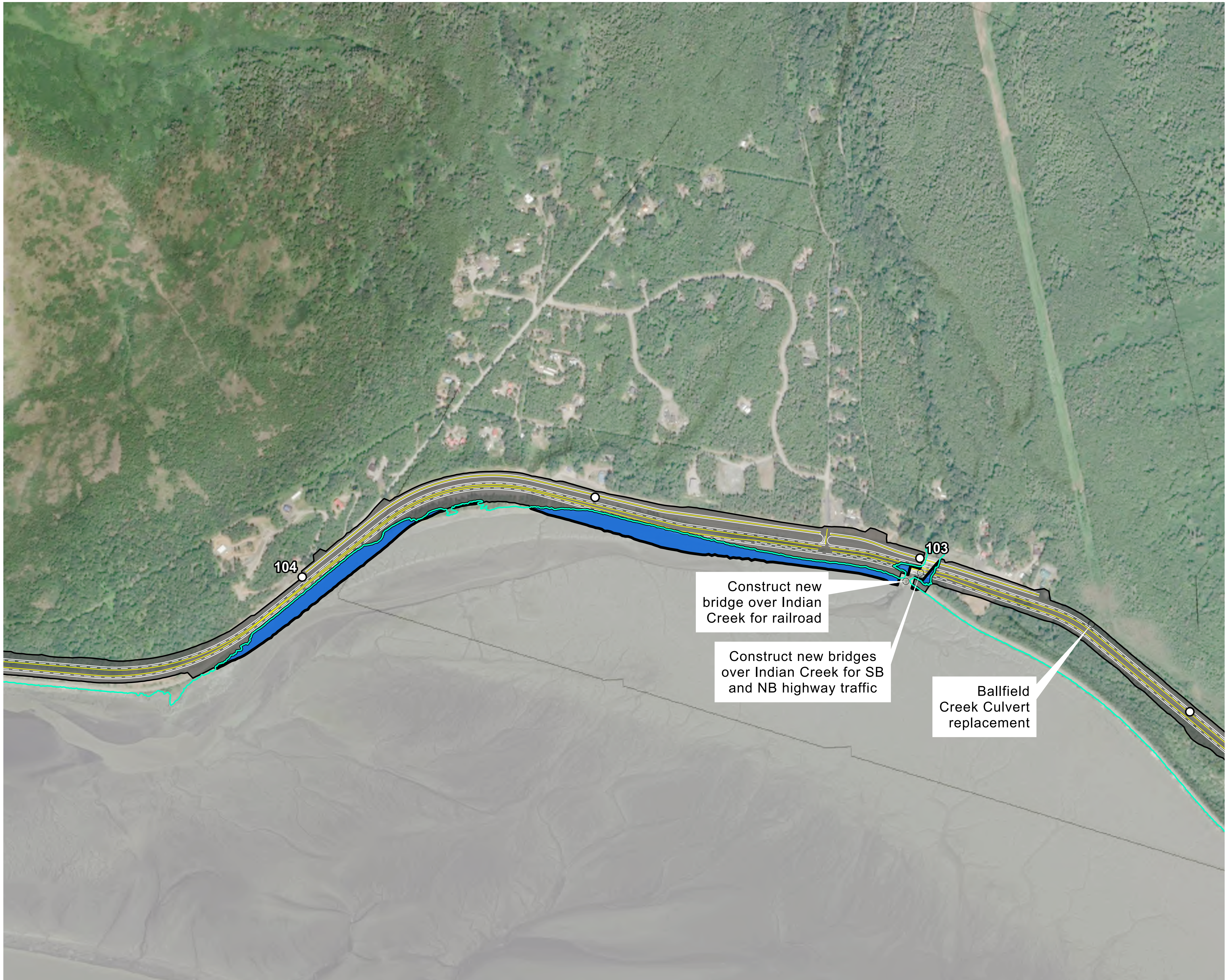
Seward Highway
Marine Habitat Impacts
Figure 7 of 9

- Mileposts
- High Tide Line
- Marine Impacts Below HTL
- Project Footprint



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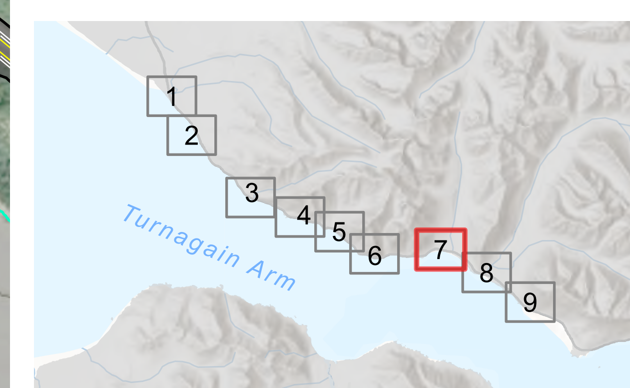

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Seward Highway
Marine Habitat Impacts
Figure 8 of 9

- Mileposts
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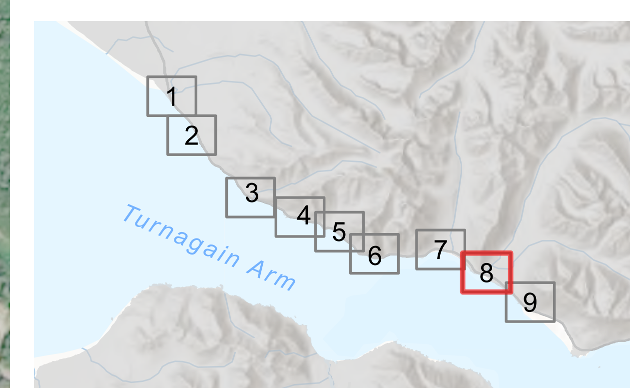

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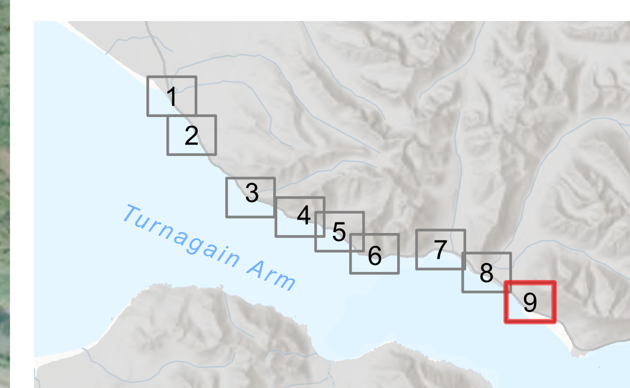
Seward Highway
Marine Habitat Impacts
Figure 9 of 9

Mileposts
High Tide Line
Marine Impacts Below HTL
Project Footprint

Essential fish habitat for the following fisheries management plan species:
Alaska Plaice and Rex Sole (egg and larvae); Dover Sole, Flathead Sole, Northern Rock Sole, Southern Rock Sole, and Pacific Cod (larvae); Yellowfin Sole (egg); Coho, Chinook, Chum, Pink, and Sockeye Salmon (estuarine and marine juvenile and marine immature and maturing adult)



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MEMORANDUM OF AGREEMENT

BETWEEN

ALASKA DEPARTMENT OF FISH AND GAME

AND

ALASKA DEPARTMENT OF TRANSPORTATION AND PUBLIC FACILITIES

FOR THE

DESIGN, PERMITTING, AND CONSTRUCTION OF CULVERTS FOR FISH PASSAGE

This MEMORANDUM OF AGREEMENT (MOA) is made and entered into between the Alaska Department of Fish and Game, P.O. Box 115526, Juneau, AK, 99811-5526, hereafter referred to as the ADF&G, and the Alaska Department of Transportation and Public Facilities, 3132 Channel Drive, Juneau, AK, 99811-2500, hereafter referred to as DOT&PF. ADF&G enters into this agreement under the authority of 16.05.841 – 16.05.861, 16.05.871 – 16.05.901, 16.20.050 – 16.20.060, 16.20.530 and 5 AAC 95. DOT&PF enters into this agreement under the authority of AS 19.05.010 – AS 19.05.125. This MOA supersedes the August 3, 2001, ADF&G & DOT&PF MOA of the same title.

I. BACKGROUND AND PURPOSE

Anadromous and resident fish depend on reliable passage through drainage structures when migrating to spawning, rearing, and over-wintering grounds. Barriers to fish passage can be a substantial factor in fish distribution and use of available habitat.

In fulfillment of its mission, DOT&PF applies for numerous ADF&G Fish Habitat permits for culvert related work in fish bearing waters. In 2001, recognizing the need for an agreement to provide uniform and consistent guidance to project design and permitting, DOT&PF and ADF&G developed an MOA for the design, permitting and construction of culverts to provide for efficient fish passage.

The State of Alaska is committed both to the maintenance and conservation of its fisheries resources and development of its transportation infrastructure in a safe and economic manner. Therefore, ADF&G and DOT&PF agree to use the procedures, design criteria and guidelines identified in this MOA to ensure that, where DOT&PF and ADF&G have determined that culverts are the appropriate stream crossing structure and are utilized by fish, they are designed and installed to provide efficient fish passage. These procedures, design criteria and guidelines clarify and make certain that individual project review and permit requirements under AS 16.05.841(hereafter referred to as 841), AS 16.05.871 (hereafter referred to as 871), and 5 AAC 95.400 – 5 AAC 95.990 with respect to fish passage requirements through culverts are met.

This agreement extends solely to the design, permitting, and installation of culverts in fish-bearing waters. This includes new culvert installation, culvert replacement and modification of culverts. To the maximum extent feasible and practicable, retrofits of existing culverts shall comply with the relevant portions of this agreement. Non-complying culvert installations or retrofits will be authorized by ADF&G on a case-by-case basis. This agreement does not apply to routine culvert maintenance activities. The agreement does not address any other statutory or regulatory responsibilities of ADF&G or DOT&PF. Additional factors unrelated to fish passage (such as unique environmental considerations, locating culverts in anadromous fish spawning or high-value rearing habitat, or other public safety, engineering, or economic issues) will be addressed on a project specific basis.

II. APPLICATION

This agreement applies to each agency as a whole and specifically to all headquarters, regional, and area personnel within ADF&G Habitat Section, and all personnel within the DOT&PF Statewide sections, and regional Design, Construction and Maintenance sections.

III. ADF&G and DOT&PF mutually agree:

A. To apply procedures, design criteria, and guidelines set forth in Exhibit A for the design, permitting, and construction or modification of culverts in fish-bearing waters. ADF&G and DOT&PF recognize that ongoing research is providing new tools and insight into fish passage design. Therefore, both agencies agree to, every five years, review the procedures, design criteria, and guidelines as set forth in Part VI.D and to amend this agreement, if necessary, to accommodate new information.

B. That DOT&PF is responsible for the selection, project engineering and technical design of fish passage structures consistent with the procedures, guidelines and criteria contained in Exhibit A. DOT&PF will request assistance from ADF&G as needed to interpret and apply fish passage criteria.

C. That ADF&G is responsible for identifying fish-bearing waters, including type of stream (841, 871, or non-fish-bearing) and primary species present. Where applicable, ADF&G may also be responsible for identifying fish species and fish length(s) to be used for culvert design, the time of year fish passage may not be impeded, anadromous spawning locations, high-value rearing sites, and, establishing in-water work windows, as necessary.

D. That disagreements involving interpretation of whether the provisions of this MOA have been fully complied with may be elevated first to ADF&G and DOT&PF's regional supervisors, and secondarily to ADF&G's Habitat Section Operations

Manager and DOT&PF's Chief Engineer, for timely and final resolution. Both agencies recognize the value of this process. Staff in both agencies are encouraged to make use of this process rather than allowing a disagreement to remain unresolved. Nothing in this MOA prevents either agency from resolving permit disagreements in accordance with the provisions of AS 16.05.841—16.05.891, AS 44.62.330—44.62.630, 5 AAC 95.710(c), and 5 AAC 95.920.

IV. DOT&PF agrees:

A. To coordinate with ADF&G during the earliest possible project phase on all projects potentially affecting fish-bearing waters.

B. To timely notify ADF&G of proposed changes to permitted fish passage culverts.

C. To have all proposed fish passage culvert structures reviewed by the Regional Hydraulic Engineer or other qualified technical experts for compliance with the procedures, guidelines and design criteria contained in Exhibit A.

D. To provide ADF&G reasonable opportunity to inspect culverts (site visit or remotely using photos or other methods of site documentation) to ensure that all culverts are installed in accordance with Fish Habitat Permit terms and conditions.

V. ADF&G agrees:

A. To timely identify all fish-bearing waters that require fish passage and to provide a list of species and life stages present.

B. To timely provide DOT&PF with all available and applicable information listed in III.C of this MOA early in the design process.

C. To request additional information, if needed, in a timely manner and in a consolidated form.

D. To provide timely approval of Fish Habitat Permits for culvert installations that comply with this MOA.

E. To timely notify DOT&PF whether proposed changes to permitted fish passage culverts require amendments to the Fish Habitat Permit, and what additional information/analysis is needed if a permit amendment is required (see Sec. IV.B).

VI. MUTUAL AGREEMENT AND UNDERSTANDINGS.

It is mutually agreed that:

A. Nothing in this agreement obligates any party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law and administratively allocated for these purposes.

B. Nothing in this agreement is intended to conflict with federal, state, or local laws or regulations.

C. External policy and position announcements relating specifically to this agreement may be made only by mutual consent of the agencies.

D. Both agencies shall meet jointly on at least a five-year basis to discuss matters relating to this agreement. Many of the criteria, guidelines and assumptions contained in this agreement are based on the current best available information.

E. For minor updates to this agreement the approval is required by the ADF&G Habitat Operations Manager and the DOT&PF Chief Engineer. Minor updates will be appended to this agreement.

F. It is recognized that changes may arise over the service life of a culvert that could impact its functionality (e.g., flooding above the design discharge and other natural events).

G. The effective date of this agreement shall be from the date of the final signature.

H. Either party may terminate its participation in this agreement by providing the other party written notice 30 days in advance of the date on which its termination becomes effective.

SIGNATURES

DocuSigned by:
4/14/2025
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Lauren Little, P.E., Chief Engineer
Alaska Department of Transportation
and Public Facilities

DocuSigned by:
Ben Mulligan
4/14/2025
939B66571A4D4AB...
Ben Mulligan, Deputy Commissioner
Habitat Section
Alaska Department of Fish and Game

Signed by:
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Ryan Anderson, Commissioner
Alaska Department of Transportation
and Public Facilities

DocuSigned by:
Doug Vincent-Lang
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Douglas Vincent-Lang, Commissioner
Alaska Department of Fish and Game

EXHIBITS

EXHIBIT A
Design, Construction and ADF&G Permitting of Culverts in Fish-Bearing Waters

Contents:

Section 1. Background and Purpose

Many water bodies in Alaska contain one or more species of resident or anadromous fish. Fish migrations in these water bodies involve completing one or more cycles of upstream and downstream movements. Fish migrations may occur during all or part of the year depending on the fish species and life stage. Fish migrate to spawn, feed, seek refuge, and overwinter.

To maintain viable and healthy fish populations, all life stages of fish must be able to freely migrate within these water bodies. Mature adult fish must be able to reach spawning grounds. Since anadromous fish species typically cease feeding when they enter freshwaters to spawn, migration delays can deplete stored energy reserves and impact reproductive success. For juvenile fish, delays in reaching feeding areas, over-wintering habitat, or predator relief areas may affect survival. Some of the most productive rearing habitats are in tributaries of major rivers.

Exhibit A describes the procedures, criteria and guidelines that will be used for culvert related work in fish-bearing waters. The procedures, criteria and guidelines are adopted under this MOA. Users of these procedures, criteria and guidelines should read the entire MOA and enabling statutes and regulations.

The procedures, criteria and guidelines contained in this agreement are minimum standards to ensure fish passage at a wide variety of locations. The guidelines should be applied considering site specific factors and design objectives for each culvert crossing site. There may be cases in which culvert designs exceeding these minimums are selected. Similarly, there may be cases where minimum recommended guidelines are appropriate to meet design objectives. Open communication between the ADF&G and DOT&PF is encouraged throughout the design and permitting process to ensure that design objectives are clearly communicated and understood.

Definitions of terms used in the agreement are contained in Exhibit B. References are cited in the agreement to provide additional context for users in Exhibit C.

Section 2. General Planning

Cross drainage structures, including fish passage culverts, are a substantial part of typical highway project costs. Fish passage can be provided at road crossings through consideration of hydrologic, hydraulic and environmental factors. Guidelines and criteria for siting culverts are discussed in the *Alaska Highway Drainage Manual* and *Alaska Highway Preconstruction Manual*. In addition to engineering considerations, siting considerations can include the location of spawning habitat, location of drainage divides or proximity to natural slope breaks, stream widths versus floodplain widths, icing problems, future access needs, vehicle design speed and vehicle sight distance.

As discussed in Section 5 – Fish Habitat Permit Application Procedures – where practicable, joint site visits to potential culvert sites by DOT&PF and ADF&G personnel are recommended to encourage open communication and collaboration.

Section 3. Culvert Guidelines

Culverts in fish-bearing streams will be designed and permitted using one of the following design approaches. The design approaches are presented in a tiered manner, which encourages use of the stream simulation approach by (1) decreasing the level of detailed engineering required for fish passage consideration and (2) increasing assurances that the structure will receive ADF&G authorization. It is the engineer's responsibility to determine which design method best fulfills all objectives of design, including site conditions, alignment, and project schedule. Tier 1 design most closely replicates natural stream conditions. Each succeeding tier further deviates from natural stream conditions and consequently will require progressively more detailed engineering and analysis to ensure that fish passage is provided.

Tier 1. Stream Simulation Design. (*Applicable to "standard" installations: full invert* culvert*, embedded and backfilled with substrate. Tier 1 culverts are recommended for new or replacement installations. The stream simulation method is applicable in culvert gradients up to six percent. Culvert gradients greater than six percent may be applicable when supported by hydraulic analysis of substrate stability. "Non-standard" installations, including open bottom culverts, require Tier 3 analysis.)*

Culverts designed using the stream simulation method are sized larger than culverts sized hydraulically for floodwater conveyance alone. The recommended minimum culvert width for Tier 1 culverts is 1.2 times the Ordinary High Water (OHW) or 1.2 times the bankfull width of the natural channel. The 1.2*OHW or 1.2*bankfull culvert width allows space for constructed streambanks within the culvert barrel and assumes that the constructed channel width within the culvert barrel is approximately equal to the natural channel OHW or bankfull width.

Constructed streambanks within the culvert barrel are not required to meet Tier 1 guidelines. In some cases (e.g., permafrost, aufeis/icing risk, wetland complex channels, intertidal settings, etc.) it may be appropriate to design culverts without constructed streambanks within the culvert barrel. For culverts without constructed streambanks within the culvert, the minimum width for a Tier 1 culvert is 1.0*OHW or 1.0*bankfull.

The culvert gradient should approximate the channel gradient, but in no instance should it deviate more than +/-1% from the natural channel grade (e.g. a 3% channel gradient with an installed 4% culvert gradient). In stream channels with gradients less than 1% (e.g. palustrine, estuarine, wetland complex and flood plain channels), culverts should be installed at slopes within 0.5% of the natural channel gradient.

Channel gradient and OHW or bankfull width should be determined using a reference reach on the water body being crossed, where practicable. In cases without a suitable reference reach, other mutually accepted methods to estimate channel gradient and OHW or bankfull width may be utilized.

The Vertical Adjustment Potential (VAP) of the stream in the vicinity of the culvert should be considered in selecting the shape, vertical alignment, and embedment depth of the culvert. For additional guidance on VAP considerations refer to Chapter 5 of USFS (2008).

Invert embedment depths for Tier 1 circular culverts should be approximately 40% of the culvert diameter. For non-round culvert shapes where the span is greater than the rise the embedment depth should be approximately 20% of the culvert rise. The selected invert embedment depth should place the widest portion of the culvert cross section at the approximate OHW/bankfull elevation or floodplain elevation, where applicable.

Within the culvert barrel, substrate material should remain dynamically stable at all flood discharges up to and including a 2% Annual Exceedance Probability (AEP) discharge (Q_{50}). Where practicable, the substrate should approximate the gradation of the naturally occurring streambed material. For crossings without an adequate upstream sediment supply, the substrate material within the culvert should be designed to resist predicted critical shear forces up to the 1% AEP discharge (Q_{100}).

For culverts with a steep gradient (typically greater than 6%), substrate retention sills that allow bed load to continuously recruit within the culvert barrel may be necessary. If substrate retention sills are used, they should have a weir height of 0.5 times the culvert invert embedment depth. Consideration of substrate retention sill shape should be given to ensure that they would not create a fish passage barrier if exposed to flow at installations where there is a risk of substrate loss.

Low flow channels constructed within the culvert substrate and associated channel erosion protection countermeasures will typically be necessary to mimic stream conditions during low flow. Where low flow channels are proposed, material defining the low flow channel should be designed to resist predicted critical shear forces up to the 1% AEP discharge (Q_{100}).

An assessment should be prepared evaluating the low flow characteristics of the proposed culvert design. In some cases, it may be agreed that substrate and/or low flow channels are not necessary (e.g. locations with backwater conditions - tidal and/or low gradient, wetland systems, etc.).

If the above criteria are followed, it is assumed that fish passage is met and no further hydraulic analysis to support fish passage is required. The initial cost for installing oversized culverts under the stream simulation approach is greater than the cost of culverts sized strictly for hydraulic capacity. However, higher initial costs may be offset by lower life cycle costs, improved resilience, and a simpler, more streamlined permitting process.

Tier 2. Design Utilizing Fish Passage Analysis Software. *(For retrofit of existing installations or new installations where Tier 1 is not practicable or preferred).*

Tier 2 uses the swimming capability of the design fish species and length to create favorable hydraulic conditions throughout the culvert crossing. Culverts are designed using a combination of traditional hydraulic engineering analysis methods (e.g., HDS 5/HY-8) and U.S. Forest Service's FishXing software program. Other fish passage analysis software may be utilized, on a case-by-case basis, upon mutual agreement for the specific project.

Adoption of any other alternative fish passage analysis software for use statewide requires joint approval from DOT&PF Chief Engineer and ADF&G Habitat Operations Manager, per VI.E.

Tier 2 designed culverts must meet the site specific fish passage conditions up to the fish passage design discharge - Q_{fish} (Section 4), and adequately pass the DOT&PF design discharge with acceptable effects on the upstream and downstream channel. Appropriate treatments will be investigated if needed to address outlet perching or upstream effects (e.g. head-cutting if the natural stream slope is not matched).

Tier 3. Hydraulic Engineering Design. (*For use where site-specific conditions preclude use of Tier 1 or Tier 2. Or for non-standard culvert installations: smooth walled culvert materials, fish passage baffles at gradients greater than 10%, open-bottom arch culverts on footings, etc.)*

Professionally recognized hydraulic engineering methods will be used to ensure site specific fish passage conditions are met in the culvert at discharges up to Q_{fish} (Section 4). The proposed culvert shall adequately pass the DOT&PF design discharge with acceptable effects on the upstream and downstream channel. Appropriate treatments will be investigated if needed to address outlet perching or upstream effects (e.g. head-cutting if the natural stream slope is not matched).

Tier 3 design requires more detailed evaluation of hydrologic, hydraulic, and biological parameters. ADF&G's permit review is proportionately more complex.

Table A-1. Summary of Fish Passage Culvert Design Options

DESIGN OPTION	BENEFITS / LIMITATIONS
Stream Simulation (Tier 1)	• Minimal design requirements, simplified permitting. • New and replacement culverts. • Assumed passage is provided for all fish species and life stages. • Culvert slope generally equals slope of natural channel. • Culvert gradients are less than 6%; or if >6%, they are supported by hydraulic analysis of the stability of substrate material within the culvert. • Stream widths are relatively narrow and incised (less than 20 feet at OHW or bankfull).
Fish Passage Analysis Software Design (Tier 2)	• Moderate design and permit review process. • Use for culverts narrower than those required for Tier 1. • Use for new, replacement and retrofit culverts when gradient and virtual mass forces are significant and must be considered at culvert inlet and outlet. • Low to moderate gradient slopes. • Baffled culverts up to 10% slope. • Target fish species and life stage identified for passage model. • Suitable for any size watershed or length of pipe.
Hydraulic Engineering Methods Design (Tier 3)	• Detailed design and review process. • Must be used for all baffled culverts when installation slope is greater than 10%. • Appropriate for use when installation includes downstream weirs or other tail water control structures.
Applied Research	• Experimental structures. Joint DOT&PF/ADF&G decision and agreement. • Detailed engineering and permitting requirements. • Must include post-construction monitoring and remediation guarantees.

Culvert Guidelines - Technical Notes

A. A crossing that maintains ecological connectivity over the long term has a cross-section area, slope, and streambed similar to that of the upstream channel and does not disrupt the natural channel pattern.

B. A minimum diameter (or equivalent for non-round shapes) of 6 feet is recommended for culverts designed for fish passage. This recommendation is based on constructability concerns for culverts smaller than the recommended minimum size. Where site conditions preclude installation of culverts less than the recommended minimum, smaller culverts may be utilized upon mutual agreement.

C. For Tier 2 and Tier 3 culverts at least one-fifth of the diameter or 18 inches, whichever is less, of each circular culvert or at least 12 inches of the height of each elliptical or arch type culvert should be embedded and backfilled with substrate, at both the inlet and outlet of the culvert, below the natural channel thalweg.

   (*NOTE: This embedment guideline may not be met in all cases. Routinely depressing the culvert invert generally increases barrel roughness tail water depth, and provides greater likelihood that, over time, downstream channel degradation will not result in a perched culvert.)*

D. Generally, culvert boundary roughness is a necessity for successful fish passage. For typical Tier 1 culverts with constructed streambanks within the culvert barrel boundary roughness is provided from the constructed streambed and banks up to the fish passage design discharge. For culvert installations without constructed streambanks, corrugated steel structural plate pipes with 6-inch by 2-inch corrugations or corrugated structural aluminum plate pipes with 9-inch by 2.5-inch corrugations are recommended. Spiral (helical) and smooth-wall culverts are discouraged for installations without constructed streambanks, except at low gradient sites (<0.5%) due to their low Manning's n values. Turbulence in the fish-swimming zone near culvert walls with shallow depth corrugations has been observed to negatively impact passage of juvenile salmonids. Larger depth corrugations also create turbulence; however, field observations suggest the width of the low velocity zone immediately adjacent to the culvert wall with larger depth corrugations is adequate to provide a free passage zone outside the negative influence of turbulence.

E. The erosion potential of streambed material at culvert outlets should be evaluated. Appropriate treatments such as rip-rap aprons, energy dissipation pools, grade control structures or other suitable countermeasures may be necessary to avoid outlet perching. Impact-type energy dissipation structures generally are not conducive to fish passage and should not be used unless they can be designed to provide fish passage.

F. Low flow channels or forcing features constructed within the substrate (within the culvert and associated inlet/outlet treatments) will typically be necessary. [Forcing features](#) (rock bands/clusters, habitat rocks, barbs/spurs, etc.) have been observed to enhance hydraulic conditions for fish passage, maintain low flow channel durability and bedform diversity within culvert barrels.

The design of the low flow channel should approximate the depth and velocity of the natural stream. A "V" shaped thalweg section is particularly suitable for streams with very low flow periods. If the dimensions can't be directly observed from a reference reach, the low flow channel's cross-sectional area should be 15-30% of the bankfull cross-sectional area. A typical minimum low flow channel section depth of four inches (measured below the horizontal bottom chord of an approximate trapezoidal channel section) is recommended. (See Figure 1).

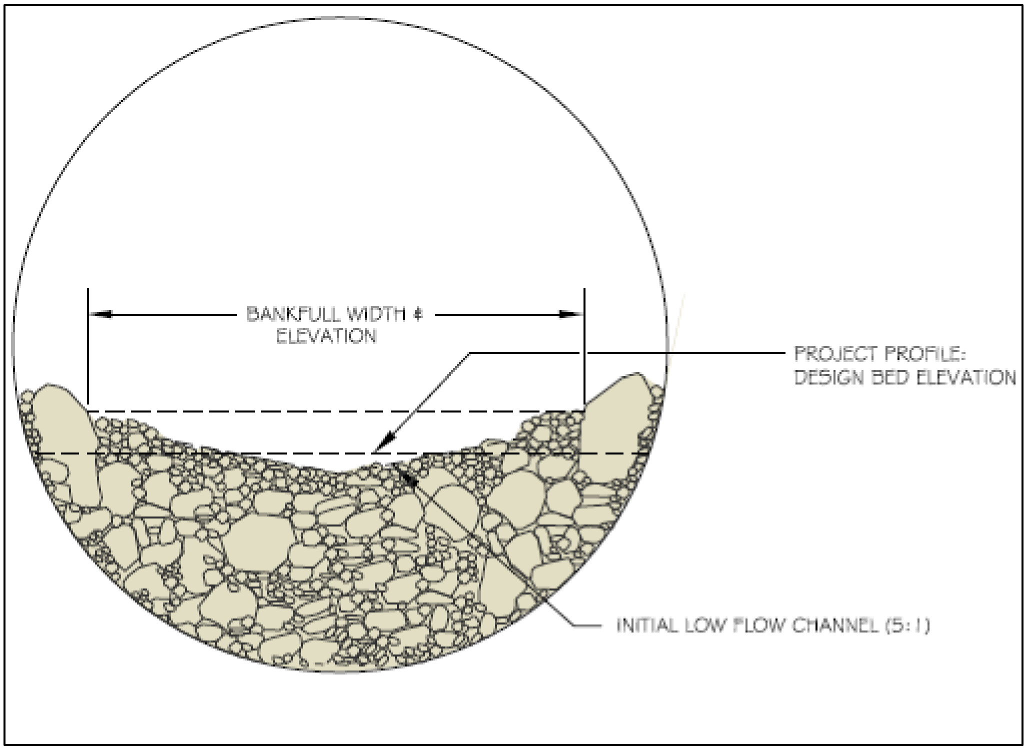

Figure 1. Low Flow Channel [USFS Stream Simulation Guide, 2008]

G. The gradation of the substrate material within a fish passage culvert shall be designed to be a dense, well-graded mixture with adequate fines to ensure that the majority of the stream flows on the surface and the minimum water depth is maintained during ordinary flow conditions.

H. Culverts with alignments skewed to the direction of flow entering the culvert should be avoided or the skew angle minimized, to the extent practicable. If the culvert is significantly skewed, hydraulic analysis of the inlet hydraulic conditions and barrel boundary layer velocity distributions may be necessary to ensure that fish passage conditions are provided. Alternately, stream realignment into/out of the proposed culvert could be considered or a wider and/or shorter culvert could be proposed to accommodate the skewed channel (see USFS Section 6.1.1.2).

I. To minimize upstream and downstream channel changes (e.g., head cutting), and the need for additional treatments, culverts generally should be horizontally and vertically aligned with the natural stream, to the extent practicable. (*See specific limitations for culverts designed using the Tier 1 – Stream Simulation approach*.) VAP should be considered in vertical alignment.

J. Where feasible, flood relief culverts should be considered to convey the floodplain discharge during greater than bankfull flow conditions. The goal is to minimize floodplain discharge through the fish passage culvert. *(Note: ensure spacing of multiple culverts does not result in the culvert battery meeting the definition of a bridge.)*

K. Culverts should be installed during low flow periods whenever possible. Where significant flow is present, generally acceptable techniques to isolate the construction site from stream flow include, but are not limited to, channel bypasses, temporary flumes, sheet pile or sandbag walls, water filled cofferdams, or pumping the stream flow around the work site. An Aquatic Resources Permit, issued by ADF&G Sport Fish Division may be required to ensure trapped fish are relocated during culvert installation.

L. Installation of trash racks or debris interceptors should be avoided unless they can be designed and maintained to have minimal effect on water and sediment discharge through the culvert, as well as fish passage.

M. Potential changes in watershed land use and/or climate change, that could affect the fish passage design discharge or channel geomorphology during the design life of the structure, should be considered when designing a culvert.

N. Vertical jumping height maxima of 1 foot for adult salmonids and 6 inches for juvenile salmonids are recommended. Jump pool depth must be at least 1.5 times the jump height or at least 2 feet deep to account for resting requirements of salmonid species. Jumping height is applicable to Tier 2 and Tier 3 designs.

O. These fish passage design criteria do not replace or supersede, the *Alaska Highway Drainage Manual*, *Alaska Highway Preconstruction Manual*, or other relevant design criteria. Both hydraulic design requirements and fish passage criteria, where applicable, must be satisfied.

Section 4. Fish Passage Design Discharge

Fish Passage Design Discharge (Q_{fish}) represents the upper bound of discharge at which fish are assumed to be moving within the stream. Q_{fish} is the estimated discharge below which fish passage will be accommodated in the hydraulic structure being designed. Q_{fish} will be lower than the design discharge for the culvert. Q_{fish} is primarily intended for use in Tier 2 and Tier 3 culvert design analyses.

- **DOT&PF's Regional Hydraulic Engineer or qualified hydraulics engineer serving as a project consultant** is responsible for developing the hydrologic estimates for the fish passage design discharge using one of the methods listed below. For ungaged watersheds, ADF&G biologists or others may have local site knowledge that would assist DOT&PF in making this determination.

- **ADF&G Habitat Section** is responsible for identifying fish-bearing waters, including type of stream (841, 871, or non-fish-bearing) and primary species present. Where applicable, ADF&G may also be responsible for identifying fish species and fish length(s) to be used for culvert design, the time of year fish passage may not be impeded, anadromous spawning locations, high-value rearing sites, and, establishing in-water work windows, as necessary.

Current formulas and models for estimating discharges for annual instantaneous peak or daily mean discharge exceedance probabilities (recurrence intervals) are based on statistical analysis of rainfall, runoff records, and/or other drainage basin parameters. These estimates are DOT&PF's best statistical estimate of discharges and have varying degrees of error. The expected magnitude of this variation can be determined, if necessary, for some discharge estimation techniques, as part of the hydrologic design procedure.

A low flow fish passage discharge has not been specified. Many streams used by fish are intermittent or may cease flowing during drought or winter conditions. An assessment should be prepared evaluating the low flow characteristics of the proposed culvert designs.

DOT&PF is encouraged to consult with ADF&G to incorporate site-specific information on design fish species & life stage, timing, and adjacent habitat information when estimating the fish passage design discharge.

Federal, state, and municipal policies directing DOT&PF's hydrologic analysis are outlined in the *Alaska Highway Drainage Manual* and the *Alaska Highway Preconstruction Manual*.

Two techniques are presented for estimating the site-specific fish passage design discharge (Q_{fish}): 1. based on the annual exceedance percentage of daily mean discharges; and 2. based on a ratio of the Q_2 annual instantaneous peak discharge. The culvert designer should select the Q_{fish} with the most supporting hydrologic data for the site.

1. Daily Mean Discharge Exceedance Estimate:

   - For culvert locations with access to spawning habitat Q_{fish} = the estimated daily mean discharge with an annual exceedance probability of 2%.
   - For culvert locations with access to non-spawning habitat Q_{fish} = the estimated daily mean discharge with an annual exceedance probability of 5%.

   Few locations in Alaska have adequate stream gaging records for estimating daily mean discharge annual exceedance probabilities. Regression equations are available for daily mean discharge annual exceedance discharge estimates by region within Alaska (USGS Water Resources Investigation Report 03-4114).

2. Ratio of Q_2 Annual Peak Discharge Estimate:

   - $Q_{fish} = 0.4 \times Q_2$ annual peak discharge

   Q_{fish} is estimated as 0.4 times the instantaneous annual peak Q_2 discharge (50% AEP). The Q_2 discharge may be determined using either a Log Pearson Type III analysis, regression equation or other hydrologic methods in the *Alaska Highway Drainage Manual*.

   At locations where adequate channel geometry is available (cross section information or average width/depth, channel slope, and roughness factor), and the channel is in equilibrium, the OHW or bankfull discharge may be estimated using Manning's Equation and substituted for the Q_2 discharge in the equation above.

Section 5. Fish Habitat Permit Application Procedures

Typical DOT&PF fish passage culvert replacement projects will go through at least two pre-application phases of coordination/consultation with ADF&G Habitat: 1.) Agency coordination during the project's Environmental process; and 2.) project design development. During the agency coordination phase DOT&PF will consult with ADF&G to determine fish presence at locations with potential culvert work. During the project design phase DOT&PF will typically consult with ADF&G on proposed fish passage culvert design concepts prior to submittal of Fish Habitat Permit application(s).

Joint site visits are encouraged in all phases of the pre-application coordination. This can be especially beneficial during the agency coordination phase to facilitate discussion. Assessments can be made of the quality and quantity of habitat, site constraints that may affect design and other factors that relate to the project. While site visits are encouraged, they may not be practicable on some projects due to remote locations, funding, schedule or other factors.

Coordination between ADF&G and DOT&PF staff during the design phase, prior to a formal application being submitted, is strongly recommended. When practicable, joint site visits to review draft plans are also encouraged. It is easier and less costly for DOT&PF to revise and modify plans while they are still in preliminary design. Optimally, all permitting details of the proposed design(s) should be resolved before a permit application is submitted to ADF&G.

Application for an ADF&G Fish Habitat Permit for a fish passage culvert structure will describe the proposed culvert installation including estimated construction sequence, timing and duration. For Tier 2 and Tier 3 designs (See Section 3), an application will also include a fish passage analysis for the design fish at the fish passage design discharge (Q_{fish} – See Section 4), and an evaluation of low flow fish passage characteristics.

A standard application form is not required for DOT&PF installations. However, a written description from DOT&PF is required for each individual culvert crossing (overflow and flood relief culverts adjacent to a fish passage culvert do not need a separate application). The application should contain the information identified in Table A-2 below. The amount of information required is directly linked to the specific design tier used. Tier 1 designs require less site-specific information than Tier 2 or 3.

Table A-2. ADF&G Fish Habitat Permit Application Information Requirements For DOT&PF Culvert Installations in Fish Bearing Waters

Tier 1 Culvert Design

1. Name of waterbody	2. Project location (Lat/Long coordinates)
3. Anadromous Waters Catalog and Fish Passage Site Number (if applicable)	4. Culvert material type and dimensions, including corrugation width and depth
5. Channel slope	6. OHW or bankfull channel width
7. Proposed culvert invert slope	8. Assessment of vertical adjustment profile
9. Culvert invert embedment depth	10. Fish passage design discharge (Q_{fish})
11. Description of natural stream substrate and proposed culvert invert substrate	12. Assessment/analysis of culvert substrate stability
13. Low flow evaluation	14. Reference reach location
15. Description of inlet and outlet scour protection (if used)	16. Estimated construction sequence, timing and duration

Tier 2 Culvert Design

1. Name of waterbody	2. Project location (Lat/Long coordinates)
3. Anadromous Waters Catalog and Fish Passage Site Number (if applicable)	4. Culvert material type and dimensions, including corrugation width and depth
5. Channel slope	6. OHW or bankfull channel width
7. Proposed culvert invert slope	8. Assessment of vertical adjustment profile
9. Culvert invert embedment depth	10. Fish passage design discharge (Q_{fish})
11. Description of natural stream substrate and proposed culvert invert substrate	12. Assessment/analysis of culvert substrate stability
13. Low flow evaluation	14. Reference reach location
15. Description of inlet and outlet scour protection (if used)	16. Estimated construction sequence, timing and duration
17. Fish species, size, and time of year (supplied by ADF&G)	18. Baffle details if used (type, spacing, height, top angle, slots, etc.)
19. Jumping height (if any) if tailwater control is required	20. Tailwater water surface elevation at Q_{fish}
21. Summary of fish passage analysis	

Tier 3 Culvert Design

1. Information required for Tier 2 design	2. Summary of hydraulic analyses supporting fish passage

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EXHIBIT B
Definitions

841-Stream requires fish passage in all fish bearing waterbodies, both resident and anadromous. (AS 16.05.841).

871-Stream is a cataloged anadromous fish stream specified under AS 16.05.871(a) and adopted by reference under 5 AAC 95.010(a).

Annual Exceedance Probability (AEP) is the probability that a of an event (flood) occurring in any year. Also see Recurrence Interval.

Annual instantaneous peak discharge is the maximum instantaneous streamflow value recorded or estimated at/for a particular site for the entire water year from October 1 to September 30.

Aufeis is an ice feature formed by water overflowing onto a surface such as river ice or gravel deposits, and freezing, with subsequent layers formed by water overflowing onto the ice surface itself and freezing.

Baffles are panels of concrete, metal or other material mounted in a series on the floor and/or wall of a culvert to increase boundary roughness and thereby reduce the average water velocity in the culvert.

Bankfull discharge is the discharge corresponding to the water surface elevation at which the floodplain of a particular stream reach begins to be flooded. The bankfull discharge is a morphological indicator that is related to the formation, maintenance, and dimensions of a stream channel as it exists under modern climatic conditions. The bankfull discharge, on average, has a flood frequency of approximately 1.5-years on the annual series. However, this frequency can vary widely depending on the particular watershed and stream reach characteristics. Bankfull discharge in one reach of a stream is rarely the same in adjacent reaches.

Bankfull width is the average of at least 3 measurements between bankfull indicator marks across the stream, collected outside of the influence of constructed features, where practicable. Upon agreement, alternate methods may be used for estimating bankfull width at locations where bankfull indicators are not applicable, not available and/or not representative of the current flow regime.

Boundary roughness is a measure of the irregularity of channel bed and banks, and/or culvert invert and sides, as they contribute to resistance to flow. For open channel flow this is commonly quantified using Manning's roughness coefficient.

Channel is a natural or artificial waterway of perceptible extent that periodically or continuously contains moving water. It has a definite bank and bed that serves to confine the water.

Daily mean discharge is the average discharge for an entire day, from midnight, local time to midnight local time.

Design discharge is used to size/design hydraulic structures. It is an estimate of a peak discharge with a specific annual exceedance probability (e.g 1% probability of occurrence in any given year).

Dynamic stability means that substrate material mobilized at higher flows will be replaced by bed material from the channel upstream of the crossing. From HEC-26: *dynamic stability means that channel dimensions, slope and planform do not change radically even though they adjust to changing inputs of water, sediment and debris. Dynamically stable channel features will fluctuate around a mean value but will stay within the predicted VAP lines.* (FHWA, 2010).

Embedment depth is the depth the culvert invert is buried into the streambed measured below the stream thalweg. Post construction channel adjustments should be considered in the embedment depth.

Fish passage design discharge (Q_{fish}) is the estimated discharge below which fish passage will be accommodated in the hydraulic structure being designed.

Forcing features are features constructed within the culvert barrel and associated erosion protection countermeasures to enhance hydraulic conditions for fish passage, maintain low flow channel durability and bedform diversity. Forcing features include rock/boulder clusters, rock/boulder bands, habitat rocks and rock barbs/spurs, among other designed features.

Grade control structure is a structure placed in a stream channel (generally with its central axis perpendicular to flow) to control bed elevation. Grade control structures can be used to control tailwater elevation and to prevent head-cutting.

Head-cutting is channel bottom erosion moving upstream through a basin and may indicate that a readjustment of the stream's flow regime (slope, hydraulic control, and/or sediment load characteristics) is taking place.

Invert is the flow line of the culvert (inside bottom).

Jumping height is the maximum vertical height that the design fish is required to jump to pass a barrier (tailwater/grade control structures, step pools, etc.). The jumping height for a design fish is a function of swimming speed and water depth.

Low flow channel is intended to provide fish passage during periods of low flow. Low flow channels are typically constructed in the substrate placed within the culvert barrel and associated erosion protection countermeasures (where installed).

Manning's Equation is an empirical formula devised by Manning for computing flow in open channels and pipes. Also called a "single section analysis".

$$Q = A*(1.486/n)R^{2/3} S^{1/2} \quad \text{[U.S. Units]}$$

Where:

Q = discharge (ft/s);
R = hydraulic radius or A/Wp (ft);
A = cross section area (ft^2);
n = Manning's Roughness Coefficient (see below);
WP = wetted perimeter (ft);
S = Hydraulic Gradient.

Manning's n is a coefficient of channel roughness, used in a Manning's Equation for estimating the capacity of a channel to convey water.

Migration is the deliberate movement of fish from one habitat to another. Includes the downstream movement of young anadromous fish from streams to sea; the upstream movement of adult anadromous fish from sea to freshwater spawning streams; the movement (upstream and downstream) of juvenile anadromous fish to rearing and over-winter habitats; and the movement (upstream and downstream) of resident fish to spawning, rearing and over-wintering habitats.

Modification is a change to the culvert structure that results in significant impact to the cross-sectional shape, conveyance, hydraulic roughness and/or structural stability.

Ordinary High Water (OHW) mark (per AS 41.17.950) means the mark along the bank or shore up to which the presence and action of the tidal or nontidal water are so common and usual, and so long continued in all ordinary years, as to leave a natural line impressed on the bank or shore and indicated by erosion, shelving, changes in soil characteristics, destruction of terrestrial vegetation, or other distinctive physical characteristics.

OHW width is the average of at least 3 measurements between OHW marks across the stream, collected outside of the influence of constructed features, where practicable.

Recurrence interval is the average time between flood events. The return interval is equal to the inverse of the Annual Exceedance Probability (e.g. 1% AEP = 1/0.01 = 100yr recurrence interval).

Reference reach is a portion of a stream that represents a stable channel (dimension, pattern, profile) within the geomorphic context that exists in that segment and can represent a natural or a stable, modified condition (USFS 2008). Where practicable, the reference reach should be outside any anthropogenic influence, including the existing/nearby drainage structure(s). A reference reach should be a minimum 20 times the reference OHW/bankfull width and no less than 200 feet in length for creeks less than 10 feet in OHW/bankfull width. A reference reach should also include a minimum of 4 stable grade control features, where practicable.

Routine culvert maintenance activities are minor repairs to the culvert and/or associated appurtenances and are not covered by this agreement. See the definition of "modification" above to differentiate between typical maintenance activities and modification. Typical maintenance activities include but are not limited to: clearing of debris from in and around the culvert; repair or replacement of marker posts; repair or replacement of thaw pipe/wire; repair or removal of culvert end sections; repair or placement of culvert scour countermeasures. A Fish Habitat permit may be required for typical culvert maintenance activities in fish bearing waters, as determined by ADF&G.

Speed is the time rate of motion divided by the time required to travel that distance. This differs from velocity because the distance is measured along the path taken, not the straight-line distance between the beginning and end point.

Substrate is a mixture of granular material placed within the culvert barrel invert to mimic the natural streambed material.

Substrate Retention Sills are plates of metal, concrete or other material welded or bolted into a culvert with a height of no more than one half of the invert embedment depth. Retention sills are intended to hold substrate in place in culverts. Retention sills should not protrude into the flow (USFS 2008).

Swimming speeds of fish vary from essentially zero to over six meters per second, depending upon species, size, and activity. Three categories of performance are generally recognized:

> **Cruising speed** is the speed a fish can maintain for an extended period of travel without fatigue. Metabolic activity in this mode is aerobic and utilizes only red muscle tissues.
>
> **Sustained (prolonged) speed** is the speed that a fish can maintain for a prolonged period, but which ultimately results in fatigue. Metabolic activity in this mode is mixed anaerobic and aerobic and utilizes some white muscle tissue and possibly red muscle tissues.
>
> **Burst (darting) speed** is the speed a fish can maintain for a very short period, generally 5 to 7 seconds, without gross variation in performance. Burst speed is employed for feeding, escape, and negotiating difficult hydraulic situations, and represents maximum swimming speed. Metabolic activity in this mode is strictly anaerobic and utilizes all of the white muscle tissues.

Thalweg is the line connecting the lowest points where water flows along a channel streambed and is the flow path during very low flows.

Velocity is the time rate of motion between two points. This differs from speed because it is the straight-line distance between two points, not the actual path taken, divided by the time required to travel between the two points.

Mean culvert cross-sectional velocity ($V_{Q/A}$) is the discharge divided by the Cross-sectional area of the flow. Usually termed "average velocity".

Mean column culvert velocity is the average velocity measured on an imaginary vertical line at any point within a culvert. A velocity measurement at 60% of the depth, measured from the surface, closely approximates the average velocity for the water column. In water greater than 76 cm (30 inches) in depth, the average of measurements made at 20% and 80% of the depth approximates the mean column velocity.

Maximum culvert velocity (V_{max}) is the highest velocity encountered in all cross-sectional profiles in a culvert.

V-occupied culvert velocity (V_{occ}) is the water velocity in the locations within a culvert where fish are actually swimming as opposed to a mean cross-sectional velocity or the maximum velocity.

Fish swimming velocity (V_{fw}) is the velocity of a swimming fish with respect to the ground. It is the summation of the V-occupied velocity and the forward rate of movement of the fish through the water.

Vertical Adjustment Potential (VAP) are elevation lines between which the streambed might vary over the service life of the structure. Vertical adjustment profile is typically estimated from the longitudinal profile of thalweg elevations collected upstream and downstream of the proposed structure crossing location. See figure below.

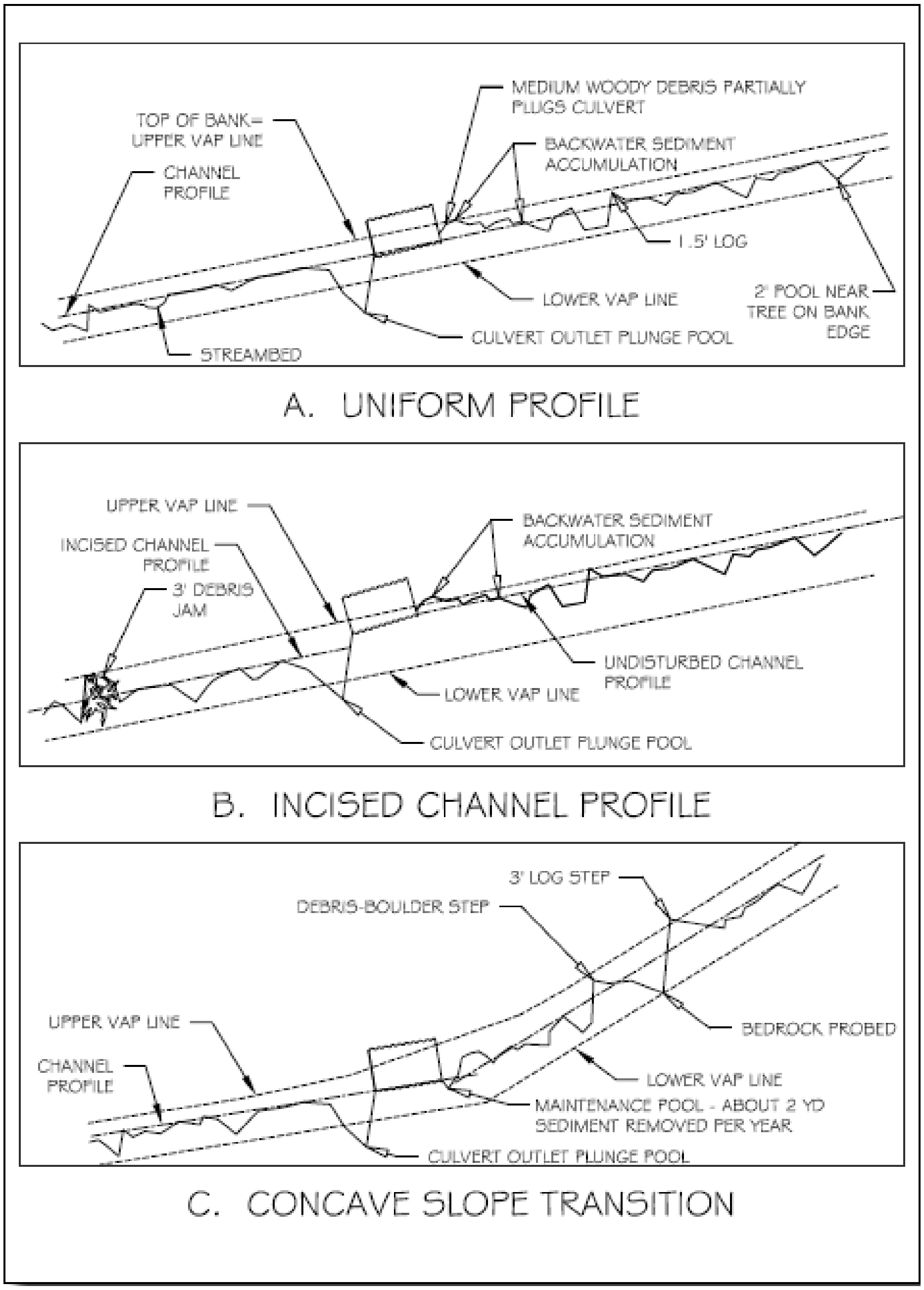

Figure 2. Vertical Adjustment Potential [USFS Stream Simulation Guide, 2008]

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EXHIBIT C
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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668

April 23, 2025

Brian Elliott, Regional Environmental Manager
Alaska Department of Transportation and Public Facilities
P.O. BOX 112500
3132 Channel Drive
Juneau, AK 99811-2500

Re: Safer Seward Highway Project, Project No. Z566310000/0A31034; NMFS ECO Reference No. AKRO-2025-01004

Dear Mr. Elliott:

The National Marine Fisheries Service has reviewed the essential fish habitat (EFH) assessment provided on April 3, 2025, regarding the above referenced project. The purpose of this project is to modify the Seward Highway to improve safety and reliability of the highway from milepost 98.5 to 118. The proposed scope of work includes widening of the Seward Highway, culvert replacements on anadromous streams, and fill placed below the ordinary high tide line of Turnagain Arm.

Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Fish and Wildlife Coordination Act require Federal agencies to consult with us on all actions that may adversely affect essential fish habitat (EFH) and other aquatic resources. The EFH consultation process is guided by the regulation at 50 CFR 600 Subpart K, which mandates the preparation of EFH assessments and outlines each agency's obligations. In support of this consultation process, you provided a notice of the proposed action and your agency's conclusion regarding impacts on EFH. We offer the following comments and recommendations on this project.

Essential Fish Habitat

The North Pacific Fishery Management Council has designated EFH for Chinook, chum, pink, sockeye, and coho salmon in the nearshore marine waters surrounding the proposed project area (NPFMC 2024a). The Alaska Department of Fish and Game's Anadromous Waters Catalog identifies eleven anadromous streams within the project area. These streams support runs of all five species of Pacific salmon (Giefer & Graziano 2024). Juvenile salmon use nearshore habitat during spring and early summer for feeding and predator avoidance prior to migration out to sea. The proposed project location is designated as EFH for other species of groundfish such as Pacific cod and Yellowfin sole (NPFMC 2024b).

Assessment of Effects to EFH

Your agency has concluded that the proposed project activity would adversely affect EFH in the project area. The EFH regulations define an adverse effect as "any impact that reduces the quality and/or quantity of EFH" (50 CFR 600.810(a)). Based on our review of the information provided, we agree with your conclusion of effects. Those potential adverse effects to EFH can be mitigated if your identified mitigation measures and best management practices are implemented, as well as the conservation recommendations below.

EFH Conservation Recommendations

Implementing the appropriate mitigation measures can avoid or minimize direct and indirect project related impacts associated with this project. In accordance with Section 305(b)(4)(A) of the MSA, we offer the following conservation recommendations to further avoid, minimize, mitigate, or otherwise offset effects:

1. Culverts should meet or exceed natural stream width, and should be designed and installed according to the guidelines established in Culvert Design Guidelines for Ecological Function, which was written specifically for Alaska salmonids (Hanson 2022).
2. Natural vegetation along anadromous streams should be retained to the greatest extent practicable.
3. Placement of fill within anadromous streams should be avoided.
4. Bridge abutments in anadromous waters should be positioned so as not to restrict flow and create a velocity barrier to migrating fish at the crossing site.
5. In-water work on anadromous streams should be conducted between May 15 and July 15 of any year to protect sensitive salmon life stages and avoid interrupting salmon migration.
6. Design drainages along anadromous streams to discharge road runoff through riparian areas prior to entering the stream.
7. If avoiding impacts to estuarine and nearshore habitat is not practicable to meet project goals, consider alternatives to the placement of fill or options to minimize the extent of fill required (e.g., elevated structures) to minimize adverse effects of shading on EFH. In a roadbuilding situation where a coastal wetland cannot be avoided, bridging is a preferred alternative to filling an embankment to create roadbeds (Johnston 1981).
8. After fully considering avoidance and minimization, evaluate and provide the appropriate compensatory mitigation for the acres of filled EFH. Identify and characterize EFH functions/services in the project area so that appropriate mitigation is selected. Mitigation bank or in-lieu fee programs that have credits available for purchase in this service area include: Portage Reserve Mitigation Bank and James Toman Mary Redmond Reserve Mitigation Bank.

Additional information related to these recommendations can be found in Impacts to Essential Fish Habitat from Non-Fishing Activities in Alaska (Limpinsel et al. 2023). Other useful resources include the Alaska EFH Mapper and our Regional website, where you can find FAQs.

Under section 305(b)(4)(B) of the MSA, Federal action agencies are required to respond to our EFH conservation recommendations in writing within 30 days. This is not a requirement for State agencies; however, a written response is requested. If your response is inconsistent with our recommendations, explain the reasons for not following our recommendations, including the scientific justification for any disagreements over the anticipated effects of the proposed action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)). Significant changes to the project may warrant reinitiating a consultation. Lucas Byker (lucas.byker@noaa.gov) is available to answer questions or discuss further actions.

Sincerely,

Catherine Coon
Assistant Regional Administrator
Habitat Conservation

cc: Simon Wigren- simon.wigren@hdrinc.com
Brian Elliott- brian.elliott@alaska.gov

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September 25, 2025

Lucas Byker
Marine Resource Habitat Specialist
222 W. 7th Avenue, Suite 552
Anchorage, AK 99513

Re: Safer Seward Highway Project, Project No. Z566310000/0A31034; NMFS ECO Reference No. AKRO-2025-01004

Dear Lucas Byker:

The State of Alaska Department of Transportation and Public Facilities (DOT&PF) acknowledges the essential fish habitat (EFH) conservation recommendations provided by NMFS on April 23, 2025 related to the Safer Seward Highway Project (Project). DOT&PF has incorporated Conservation Recommendations 2 through 6 into the Project planning and design. Below are DOT&PF's responses related to Conservation Recommendations 1, 7, and 8.

Conservation Recommendation 1: DOT&PF will follow the 2025 Memorandum of Agreement (attached) with the Alaska Department of Fish and Game for the design, permitting, and construction of fish passage culverts (https://dot.alaska.gov/stwddes/desenviron/resources/memos.shtml). The procedures, design criteria, and guidelines identified in the MOA are to ensure that culverts installed in fish streams on DOT&PF projects provide efficient fish passage. Additionally, DOT&PF will work closely with ADF&G to determine the desired design objectives for each Project culvert crossing before applying for Fish Habitat Permits.

Conservation Recommendation 7: Impacts to estuarine and nearshore wetland habitats have been minimized to the greatest extent practicable, while achieving the Project purpose and balancing impacts to other protected resources such as historic properties and Section 4(f) of the United States Department of Transportation Act protected properties. DOT&PF considered a design alternative that would double stack portions of the highway to meet the Project purpose. For example, the design could consist of northbound lanes on long bridges above the southbound lanes or the railroad tracks. Miles of bridge structures would be extremely expensive in terms of construction and maintenance. DOT&PF determined that the costs of a stacked structure would be of an extraordinary magnitude, and the impacts to the scenic nature of the highway corridor would be substantial.

Conservation Recommendation 8: DOT&PF will work with the U.S. Army Corps of Engineers during the permitting process to determine the appropriate and practical amount of compensatory mitigation necessary for unavoidable impacts to wetlands and waterbodies, which would include EFH. DOT&PF

expects that compensatory mitigation could involve the purchase of credits from nearby wetland mitigation banks with service areas covering the Project impacts.

Please feel free to contact me at (907) 269-0539 or via email at brian.elliot@alaska.gov. You may also contact our environmental consultant for the Project, Simon Wigren, HDR, Inc., at (907) 644-2189 or via email at simon.wigren@hdrinc.com.

Sincerely,

Brian Elliott

Brian Elliott
Regional Environmental Manager
DOT&PF

Attachments:
The 2025 Memorandum of Agreement between the Alaska Department of Fish & Game and the Alaska Department of Transportation and Public Facilities for Design, Permitting & Construction of Culverts for Fish Passage.

cc:
Doug Kolwaite, Statewide Environmental Program Manager, DOT&PF
Matt Dietrick, NEPA Program Manager, DOT&PF